The DoD Manufacturing Technology Program

Strategic Plan

Delivering Defense Affordability

March 2009

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PREFACE

This is the Department of Defense (DoD) Manufacturing Technology (ManTech) Program Strategic Plan, effective Fiscal Year 2009. It has been prepared in response to Section 238 of the National Defense Authorization Act for Fiscal Year 2008 that added 10 U.S.C. 2521(e), which requires the Department to develop a five-year ManTech Program strategic plan that is to be updated biennially.

This document was prepared by the office of the Deputy Under Secretary of Defense for Advanced Systems and Concepts, in close collaboration with the Joint Defense Manufacturing Technology Panel, comprised of ManTech Program leadership from each Military Department and participating Defense Agency. Additional details regarding this plan's statutory requirements and the strategic planning construct guiding its development can be found in Annexes A and B, respectively.

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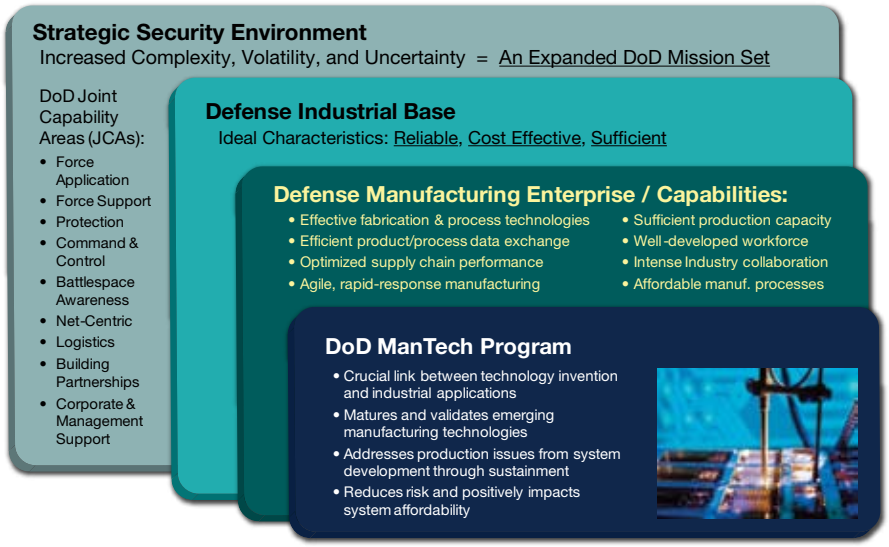
EXECUTIVE SUMMARY

For over 50 years, the DoD Manufacturing Technology (ManTech) Program has been the Department's investment mechanism for staying at the forefront of defense-essential manufacturing capability. This strategic plan is the Department's formal vehicle to unify and guide the ManTech community and support the broader defense manufacturing enterprise in delivering maximum value to the warfighter and the nation. The strategic planning process validated, through stakeholder interviews, ManTech's continued relevance in the coming years and squarely placed ManTech in the critical role of delivering affordability for defense acquisition and sustainment. This plan reinvigorates ManTech's central role within the DoD technology transition process with a renewed emphasis on the ManTech Vision and a formal statement of the ManTech Mission. These are then translated into four Strategic Thrusts and nine Enabling Goals to provide guidance and perspective for the Program.

STRATEGIC CONTEXT

Manufacturing is so important to the nation that the ManTech community is sometimes looked to as the champion for not only defense manufacturing technologies, but for the entirety of the defense manufacturing enterprise or even for enhancing US global manufacturing competitiveness. These larger topics go well beyond the charter of ManTech, but they form an important strategic context for ManTech planning. The ManTech program today exists in a strategic security environment of expanding DoD mission responsibilities and growing concerns about the affordability and responsiveness of defense acquisition and sustainment programs. Warfighter capability requirements, in turn, place demands on a defense industrial base that must be reliable, cost effective and sufficient in its response. Economic and policy analyses (including DoD's *2008 Annual Industrial Capabilities Report to Congress)* make clear that the dynamics of globalization and other

external drivers will increasingly shape the defense industrial base and the defense manufacturing enterprise. The growing intersection between commercial and military innovations has already created a climate in which the defense manufacturing enterprise must cope with the 21st century realities of widespread dependence on components from offshore suppliers. Defense manufacturing needs not only effective fabrication and process technologies, but also effective design disciplines, globally collaborative networks, and a highly capable workforce. Industry has underscored this point with studies from such associations as the National Council for Advanced Manufacturing (NACFAM), Aerospace Industries Association (AIA), National Defense Industrial Association (NDIA), and others. A recent NDIA paper, for example, identifies seven serious manufacturing issues–technology, workforce, supply chain, facilities modernization, globalization, manufacturing and local economies, and environmental issues–that need national attention. ManTech cannot solve all problems, but this Plan makes clear that the program should take this overall context into account when planning investments.



THE ROLE OF MANTECH

ManTech has a broad charter, both in statute and in DoD policy (DODD 4200.15), to improve the quality, productivity, technology and practices of businesses and workers providing goods and services to the DoD. The program's vision and mission statements are similarly broad, and are framed to address wide-ranging needs for affordability and timely delivery. The mission to anticipate and close gaps in defense manufacturing capabilities makes the program a crucial link between technology invention and industrial applications–from system development through sustainment–giving ManTech a unique identity within the extended defense enterprise. ManTech carries out its mission through programs in the Military Departments, participating Defense Agencies, and OSD. The program's demonstrated ability to improve defense system affordability makes it a particularly potent tool in

Defense Manufacturing Vision:

A responsive, world-class manufacturing capability to affordably and rapidly meet warfighter needs throughout the defense system life cycle

ManTech Mission:

ManTech anticipates and closes gaps in manufacturing capabilities for affordable, timely, and low-risk development, production, and sustainment of defense systems.

the current budget environment. A recent report to Congress identified over 100 projects funded by ManTech in FY03 to FY05 that have resulted in implementations yielding a cost avoidance of more than $6.3 billion.

The Deputy Under Secretary of Defense for Advanced Systems and Concepts administers and oversees the program through the OSD ManTech Director, with primary program execution at the Service/Agency level, and cross-component coordination via the Joint Defense Manufacturing Technology Panel (JDMTP). The JDMTP has an exemplary history of effective coordination at a technical level to ensure that programs are aligned with higher level objectives, that unnecessary duplication is avoided, and that investments have the greatest joint-service leverage.

The OSD ManTech Director and the members of the JDMTP adhere to four tenets in making policy and resource allocation decisions:

1. Address the highest priority defense manufacturing needs in the window of opportunity to make a difference.
2. Transition manufacturing R&D processes into production applications.
3. Attack pervasive manufacturing issues and exploit new opportunities across industry sectors.
4. Address manufacturing technology requirements beyond the normal risk of industry.

These tenets are applied in planning DoD ManTech investments that total over $200M per year, as shown in the following table.

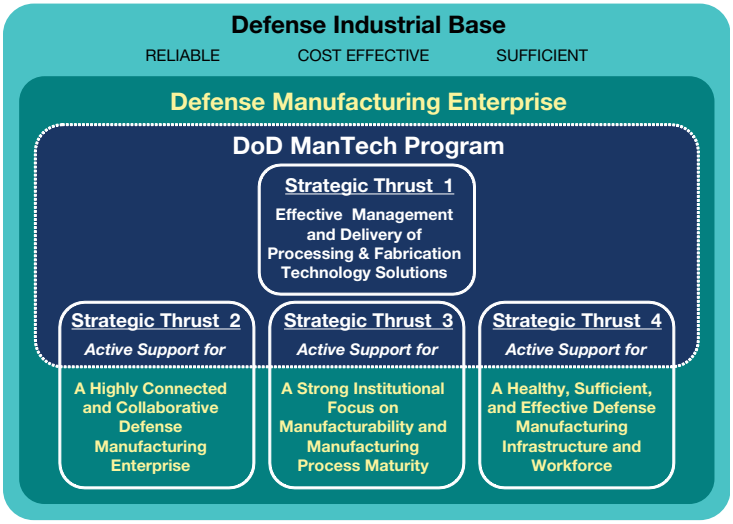
ManTech Funding, by Program Element (dollars, in millions)

PROGRAM	FY09 Approved	FY09 PB			
		FY 10	FY 11	FY 12	FY 13
DoD MS&T (PE 0603680D8Z)	18.4	14.9	19.9	19.9	24.8
Army ManTech (PE 0708045A)	91.1	69.6	70.2	71.7	73.4
Navy ManTech (PE 0708011N)	61.9	58.6	56.5	60.0	60.6
AF ManTech (PE 0603680F)	56.5	40.5	40.8	41.6	42.5
DLA ManTech (PE 0708011S)	55.3	20.8	21.3	21.7	22.0
MDA* (PE 0603890 YX29)	33.3	38.6	47.6	44.8	45.5
TOTAL**	283.2	204.4	208.7	214.9	223.3

* MDA line is the total for all Manufacturing and Producibility

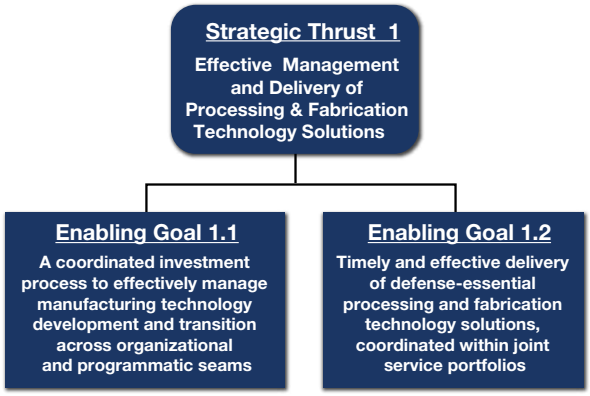
**This total does not include MDA's budget for Manufacturing and Producibility

STRATEGIC THRUSTS AND GOALS



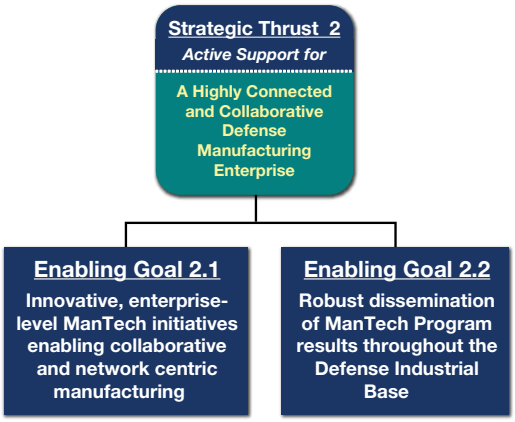
In keeping with its role to address needs in the larger context of defense manufacturing, ManTech has developed a strategy for the next five years that balances its traditional emphasis on processing and fabrication technology solutions with active support for broader defense manufacturing needs. Consequently, Strategic Thrust 1 is committed to manage and deliver processing and fabrication solutions in an area predominantly within ManTech's span of control, recognizing that ManTech is the only DoD program that has this as its primary mission. Thrusts 2, 3, and 4 commit active support for enterprise level solutions, manufacturability and process maturity, and manufacturing infrastructure and workforce, respectively, and recognize it is beyond the program's charter and resources to *fully* satisfy these thrusts. Goals are defined in all four strategic thrusts with sufficient description to enable focused action.

Strategic Thrust 1 in many ways represents the core focus of the program and drives the majority of program investment activity. It is supported by two enabling goals shown in the diagram to the right.



Goal 1.1 is to continuously improve a coordinated investment process ensuring ManTech Program adaptability and resilience, with a focus on successful transition. It recognizes the complexity of multiple organizational and programmatic interfaces across which increasingly mature manufacturing technologies need to be managed–for all phases of research, development, acquisition, and sustainment.

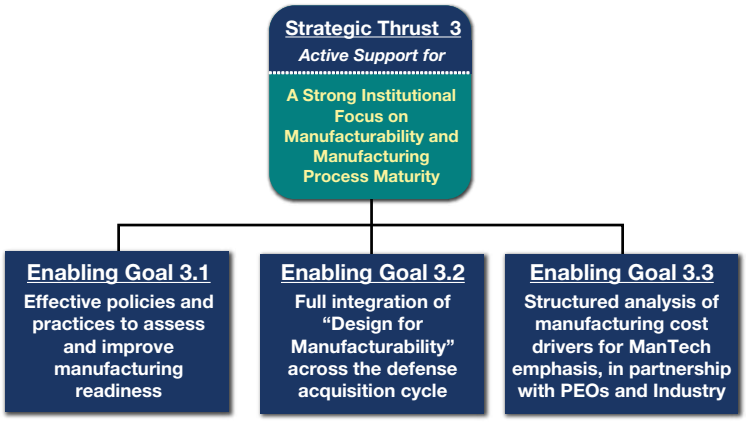
Goal 1.2 addresses the technical execution of the core ManTech Program, guided by the Goal 1.1 investment process. Technology portfolios are developed and managed by the Military Departments, Defense Agencies, and OSD using manufacturing roadmaps, analyses of defense system affordability drivers, and DoD determined priorities. The portfolios are coordinated by JDMTP joint-service technical subpanels.



Strategic Thrust 2 is the first of three program strategies applying to the broader defense manufacturing base. The cost and schedule of defense systems are driven primarily by activities "above the factory floor;" that is, in enterprise level processes, business practices and interactions with suppliers and with the government customer. 21st century defense manufacturing will rely on a networked, collaborative and increasingly global supply base, with capabilities that can be linked within and among the nodes to respond rapidly to dynamically changing defense needs.

Goal 2.1 encompasses the research, development, and implementation of capabilities which allow for a highly collaborative manufacturing environment among the multiple players in system development and production. Specific initiatives that fit include Model Based Manufacturing, Network Centric data environments, Collaborative Modeling and Simulation capabilities, and commercial practices within defense manufacturing. Each represents an innovative approach to enable stakeholders to collaborate at the enterprise level.

Goal 2.2 represents an important transition path for the results of research and development activities conducted by the ManTech program, primarily within Strategic Thrust 1. This deployment of program implementation results across the Military Departments, Defense Agencies, and industry helps to fully leverage the ManTech investment across the defense industrial base. In the best case, targeted dissemination resulting in subsequent transition into additional systems can help transform an innovative, initial manufacturing capability into a viable industry, thus benefiting all participants.



Strategic Thrust 3 points to the strategic need for a *pervasive culture of manufacturing* that embodies a cradle-to-grave focus, across DoD and industry, that persistently considers weapon system manufacturability and aggressively resolves associated production and sustainment issues over the Acquisition life cycle. This, in turn, maximizes opportunities to positively influence weapon system cost, schedule, and performance through manufacturing reviews appropriate for each phase of research, development and acquisition. This strategy seeks to drive a system-wide focus on manufacturing across these phases while ensuring that the central focus is sufficiently early in system acquisition for greatest benefit.

Goal 3.1 encompasses the development and maintenance of a body of knowledge sufficient to support the implementation of manufacturing readiness as a management criterion. A required element for this strategy is a strong institutional focus on manufacturing readiness. This will necessitate a validated scale of Manufacturing Readiness Levels (MRLs), an assessment process, and subject matter expertise to assist in performing manufacturing readiness assessments.

Goal 3.2 embodies the overarching objective of a strong institutional focus on manufacturability and producibility across the full defense acquisition framework. The full integration of "Design for Manufacturability" requires partnership with the technical community in combination with standardized practices appropriate for DoD and industry.

Goal 3.3 addresses the need to understand the highest priority opportunities for targeted manufacturing cost reduction, both within major defense systems and across multiple product lines. This is an important goal that directly supports the program's defense affordability improvement objectives, and feeds into Goal 1.1.

While the DoD ManTech Program is not structured to be solely responsible for meeting the broader industrial base needs in **Strategic Thrust 4**, it is a vital enabler for a highly effective defense manufacturing enterprise, and DoD policy requires the ManTech Program to promote the key attributes supporting these needs. Doing so is in ManTech's best interests. A healthy, sufficient, and effective defense manufacturing infrastructure, manned by a flexible, innovative and capable defense manufacturing workforce, underpins the ManTech Program's mission effectiveness and broader industrial preparedness in multiple ways.

The objective of **Goal 4.1** is to actively promote sufficient government and industry investment in new U.S. plants and equipment as well as in manufacturing management innovations, such as Lean and Six Sigma, all in support of industrial preparedness. Sustained achievement of this goal reduces the cost and risk of advancing and applying new and improved manufacturing technology.

Goal 4.2 supports a highly capable, well-trained and well-educated U.S. defense manufacturing workforce, including effective use of knowledge management for defense-essential manufacturing skills, and active support for a strong national manufacturing workforce. This goal has several aspects, aligned primarily with specific sectors of the defense manufacturing workforce, addressing both organic defense as well as non-organic/national workforce initiatives.

MECHANISMS FOR ASSESSING PROGRAM EFFECTIVENESS

Assessing ManTech Program effectiveness is essential for its proper management, coordination and oversight. Program effectiveness is assessed through various mechanisms at three levels in the ManTech Program's governance structure:

- At the execution level, within each Military Department and participating Defense Agency
- At the portfolio coordination level, by the JDMTP and its subpanels
- At the policy and oversight level, within the Office of the Secretary of Defense (OSD)

Annual reviews of these ManTech programs are conducted to ensure that each project is planned with specific cost, schedule, performance and technology transition objectives, and that each project has milestones for in-process reviews by the government program manager to assess progress toward the project objectives. Annual portfolio reviews by the JDMTP subpanels provide strong peer review of technical metrics and progress. At the program manager level, a transition plan is coordinated between the ManTech project team and the primary transition target (Acquisition PM/PEO, depot, logistics center, shipyard, company, or industry sector). Progress is tracked, project by project, through successful transition, and is reported through the ManTech governance structure.

CONCLUSION

The DoD Manufacturing Technology Program has historically demonstrated its value, not only through process technologies that make new products possible, but also through manufacturing process improvements that get at the heart of defense system affordability challenges. The dynamics of the 21st century manufacturing environment are blurring the boundaries of traditional defense manufacturing concerns, and forcing a more global perspective. The DoD ManTech program has adopted strategies and goals that will preserve its well-established focus on advancing fabrication and processing at the shop floor, and at the same time actively support advances at the enterprise and supply chain level, in design and manufacturing maturity assessments, and in the manufacturing workforce. The budgets, execution and oversight mechanisms are in place to implement these strategies. The result will be even greater realization of the vision of *"a responsive, world-class manufacturing capability to affordably and rapidly meet warfighter needs throughout the defense system life cycle."*

I. INTRODUCTION

A 50+ year heritage of essential contributions to defense manufacturing… …adapting to 21st century demands.

For over fifty years, the DoD Manufacturing Technology (ManTech) Program has been the Department's investment mechanism for staying at the forefront of defense-essential manufacturing capability. In the 20th century, when the threat was highly predictable and the U.S. defense industrial base was largely self contained, ManTech helped keep the nation positioned to produce the best military systems in the world. In the 21st century, DoD faces new threats, the industrial base is globally networked, and the definition of "best" must increasingly consider affordability. These are the new demands placed on defense manufacturing, and they are shaping the future role of ManTech.

ManTech strategic planning is focused on the imperatives to improve weapon system affordability and timely delivery to the warfighter.

This strategic plan defines the ManTech strategy for keeping DoD positioned to enhance and use 21st century manufacturing capabilities to address the growing challenges of weapon system affordability and timely delivery to the warfighter. It is structured to unify and guide the DoD ManTech community and the extended defense manufacturing enterprise in the broad context of defense needs and 21st century manufacturing capabilities. Manufacturing is so important to the nation that the ManTech community is sometimes looked to as the champion for not only defense manufacturing technologies, but for the entirety of defense manufacturing or even for enhancing U.S. global manufacturing competitiveness. These larger

topics go well beyond the charter of ManTech, but they form an important strategic context for ManTech planning.

Senior stakeholder inputs were an important information source supporting plan development.

This plan has been developed through a process of top down analysis and senior level stakeholder interviews, starting with defense needs, assessing manufacturing needs and capability gaps, and considering national and global manufacturing trends. One message from government and industry stakeholders was consistent: the DoD ManTech Program carries tremendous leveraging value for the Department, and this strategic planning cycle represents a key opportunity to strengthen that. Within that context, the plan highlights the program's key roles and potential, and it establishes ManTech strategies to best meet the needs of defense–both short-term and long-term. Further details on the strategic planning and analysis methodology are provided in Annex B. The sections that follow outline the strategy that will guide ManTech's investment targets and initiatives for a five-year planning horizon.

II. DEFENSE MANUFACTURING – THE STRATEGIC CONTEXT

…The last two decades have seen a consolidation of the defense industry around 20th century platforms. Looking ahead, the critical challenge for DoD is to employ its leadership and influence in transforming the defense industry around a 21st century National Security Industrial Structure.

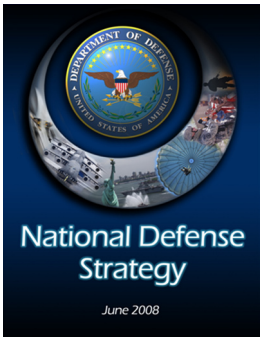
- Defense Science Board 2008 Task Force on Defense Industrial Structure for Transformation

DRIVERS OF CHANGE

Today's complex and evolving security environment is forcing DoD to adapt and expand its mission sets and capabilities in unprecedented ways.

During the Cold War, the mission of DoD was to prevail in regional conflicts and deter conventional or strategic nuclear war against a well defined enemy. At that time, military capabilities of U.S. platforms and weapons gave us a decisive edge, while U.S. investment, innovation and productivity made it impossible for other nations to keep pace. As Figure 1 from the 2006 Quadrennial Defense Review depicts, and as the 2008 National Defense Strategy emphasizes,[1]

1 National Defense Strategy, Department of Defense, Office of the Secretary of Defense (2008), p. 1



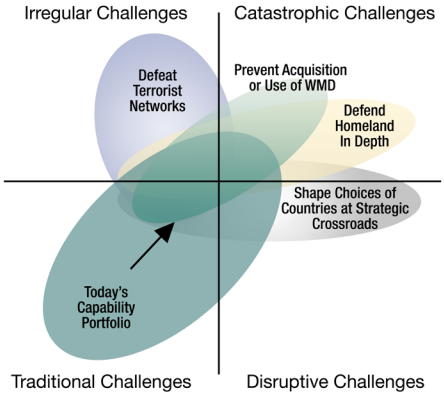


Figure 1. Emerging Security Challenges

today's DoD faces increased challenges wherein it must continue to be capable of conventional and strategic deterrence against a potential peer adversary and to win in regional conflicts, simultaneously adding capability to deal with irregular warfare, catastrophic challenges, special operations, and stability operations anywhere on the globe where U.S. interests are at stake. In terms of the materiel capabilities that must be resourced and provided, little is being removed from DoD's mission set as new requirements are added.

The management and resourcing of DoD's expanding capability portfolios will require ever higher levels of coordination between the Military Departments, Defense Agencies, and Combatant Commanders, overseen and integrated by OSD and the Joint Staff.

This environment will continue to put increasing pressures on the USD(AT&L)'s strategic vision to "drive the capability to defeat any adversary on any battlefield."[2] In essence, traditional missions must continue to be resourced

2 USD(AT&L) Strategic Goals Implementation Plan V3.0 (2009), p. 2.

USD(AT&L) Vision

with modernized capabilities while new and emerging missions are driving requirements for competing resources and new technological solutions. As stated in the USD(AT&L) Strategic Goals Implementation Plan, "Our systems must be flexible enough to respond to the many means terrorists or hostile forces might employ," and "We must also reinvent ourselves, our processes, and our thinking continuously–not just when there is a new crisis or new foes threatening our national security."[3] This mandate places a premium on both rapid and robust manufacturing responses across multiple, dynamic scenarios. The aggregate effect of this widening of defense missions is an unprecedented diversity in the demands placed on the DoD and on the defense industrial base.

GLOBALIZATION AND THE DEFENSE INDUSTRIAL BASE

"Militarily-relevant technology will continue to change rapidly and will be increasingly global."

- DSB 2008 Task Force on Defense Industrial Structure for Transformation

Globalization trends clearly add complexity to DoD's Industrial Vision of a *reliable, cost effective*, and *sufficient* industrial base,[4] demanding flexibility and adaptability. Just as the security of the United States is increasingly interwoven into the security of the broader international system, the industrial capability on which the DoD relies is more tightly bound to a broader international supply and manufacturing base. The technologies important to defense will, in the 21st century, increasingly come from sources other than DoD labs and defense contractors. This is particularly true in electronics and network technologies, where the DoD, as a producer, has become dependent on commercial innovation and production.

3 Ibid.

4 See *Annual Industrial Capabilities Report to Congress* (March 2008), p. 1.

Globalization is creating a growing intersection between commercial and military innovations, in which the defense industrial base must increasingly depend on commercial, global, and non-traditional sources of innovation and production.

The commercial trend in manufacturing is toward a hypercompetitive global marketplace, driven on the supply side by a growing number of nations striving to develop strong manufacturing economies, and on the demand side by seemingly insatiable appetites for higher quality, content, and customization at lower prices. These dynamics are made even more complex by reduced time-to-market pressures and shorter product development life-cycles, as well as rapid obsolescence and "throw-away" product lifetimes. The DoD and defense contractors find themselves increasingly dependent on these commercial and global supply chains and practices, and must be as adept as our potential adversaries in rapidly translating new technologies into high-performing military capabilities, often at a faster rate than typical defense product cycles.

Defense manufacturing capabilities must be adapted to accommodate 21st century realities and ensure a reliable, cost effective and sufficient defense industrial base.

These global trends are driving the need for U.S. defense manufacturing capabilities to accommodate 21st century realities. The dependence of the U.S. defense market on supplier networks whose survival is affected by this global competitive base is captured in the popular phrase "The World is Flat" (Thomas Friedman, 2005). In addition to looking inward to its laboratories and traditional defense suppliers for material solutions to meet new missions, DoD will also need to look outward to commercial, global and non-traditional sources of innovation and production. DoD will need to rely on better supply chain business practices and technologies, as well as assured sources to mitigate the risks for critical components and materials.

Globalization is profoundly impacting the capabilities of the U.S. defense manufacturing workforce.

Global competition also affects the manufacturing workforce on which DoD relies. Demographics in the U.S. will lead to the loss of a significant portion of today's manufacturing workforce as retirements increase. There will be continued pressure to replace these critical workforce skills and experience. Industry assessments have concluded that competitive success will require innovation in both product and process development as well as improvements in workforce skills and knowledge. This creates an urgent need to develop a skilled and knowledgeable replacement workforce, and to develop ways to achieve more output with fewer experienced workers.

Defense manufacturing is also affected by growing global concerns about environmental and energy stewardship. Since U.S. manufacturers need to sell in a global market, standards for environmentally benign manufacturing in

Environmental and energy stewardship issues will continue to influence defense manufacturing practices and capabilities.

Europe and elsewhere are driving changes in our domestic manufacturing practices and technologies. These same standards are driving changes in how we procure materiel and sustain systems. Industrial efforts must continue addressing the need to reduce hazardous elements like cadmium, chromium, and lead, as well as pursuing alternative energy sources and reduced energy consumption, including decreasing the environmental footprint and dependence on foreign energy sources.

A network-centric approach will be an increasingly important leveraging tool in the new millennium.

Recent industry studies of "Network Centric Manufacturing" and "Model Based Enterprise" concepts suggest that these initiatives hold promise, and that networks of business relationships and collaboration skills in the workforce, enabled by information networks and computer simulations, will be key to meeting the urgent need to adapt. A network-focused approach, organized around the objective of achieving a "single digital thread," helps fully leverage innovations from all tiers in the supply chain and throughout the extended enterprise and across the total life cycle of products ranging from complex systems to legacy parts. DoD has an important stake in seeing that this need is met.

PRESSURES ON AFFORDABILITY AND TIMELY DELIVERY

The problem of affordability of the defense acquisition portfolio has become acute. The Government Accountability Office's (GAO) 2008 annual report found that of 72 major acquisition programs reviewed, almost half experienced cost growth exceeding 25 percent. For the 2007 portfolio as a whole, total acquisition costs increased by 26 percent from first estimates compared to six percent for the 2000 portfolio.[5] This worsening trend occurs at a time when programmed funding for acquisition is at its highest level in twenty years, and funding pressures in other parts of the defense budget are mounting. The inevitable effect of fixed or declining modernization budgets coupled with increasing unit costs is declining numbers of systems actually reaching the field. Portfolio funding pressures often compound the problem by driving stretch-out of programs and a spiral of increasing unit costs, reduced quantities, and longer time to deliver capability to the field. The cumulative effect of affordability transcends individual program acquisitions and begins

5 Government Accountability Office, *DEFENSE ACQUISITIONS Assessments of Selected Weapon Programs*, GAO-08-467SP (2008), p. 7.

to constrain broader DoD modernization investment options as well as vital operations and sustainment spending decisions.

Weapon system cost and schedule overruns are traceable to multiple factors.

The causes of acquisition cost growth are many and complex. At a summary level, the GAO has found that cost and schedule overruns are traceable to such factors as lack of requirements stability, program management turnover, use of immature technology, and entry into development and production without mature manufacturing processes. While many of these factors extend beyond manufacturing, manufacturing plays a key role. Figure 2, a high-level decomposition of the Defense Affordability problem, depicts the broad set of contributing defense manufacturing challenges facing the Department. Manufacturing technology issues relate to all of these challenges, and given the acute nature of the defense affordability problem, the subject is a focusing theme of this strategic plan. The need for such emphasis was repeatedly reinforced in stakeholder interviews and other feedback given during the strategic planning process. ManTech has a clear role in addressing the manufacturing related drivers of affordability, and the program must be attuned to other cost drivers as well to contribute to a good overall systems solution.

Decomposition of the Defense Affordability problem reveals important, underlying manufacturing challenges.

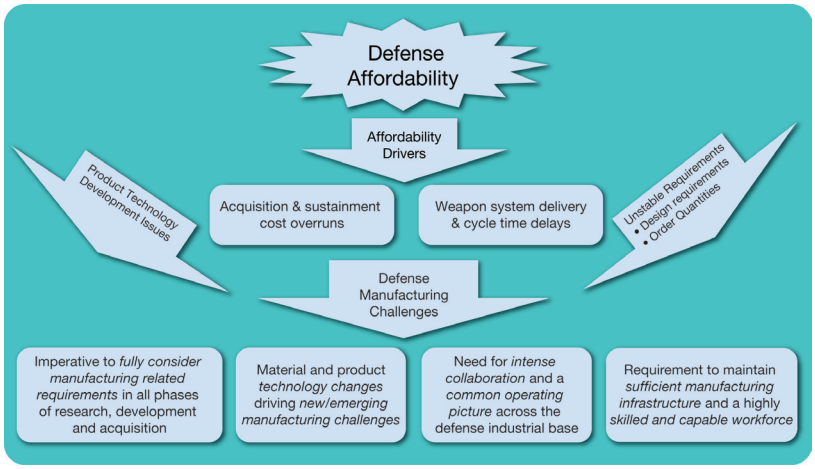


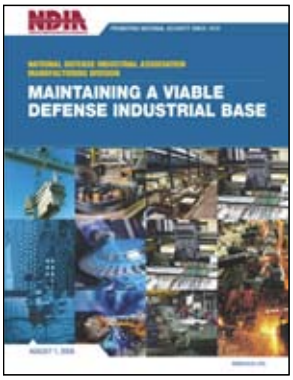
Figure 2. Manufacturing Challenges Contributing to Defense Affordability

Time-to-field also matters, and this strategic plan typically views it within the context of affordability (as done in Figure 2), given the multiple, often circular, cause-and-effect relationships that rapid delivery and timeliness have with

Time to field is another significant challenge, with components both related to and independent of defense affordability.

affordability. This strategic plan also addresses time-to-field independently, including ManTech's vital contributions to that need. DoD acquisition processes are designed for major system procurements, where product cycle times are significantly slower than in the commercial sector. This slowness in platform acquisition is driven more by available budget than by manufacturing rate capacity. For response to urgent warfighter needs in irregular and special warfare, this slow pace is unacceptable, especially in situations where our adversaries are using fast moving commercial technologies. In these cases, rapid response manufacturing and delivery capabilities are paramount to operational readiness and must be developed and transitioned quickly. ManTech can prove central to achieving those needs.

IN SUMMARY



Defense manufacturing in the 21st century is framed by these strategic challenges. In its recent white paper entitled "Maintaining a Viable Defense Industrial Base," the National Defense Industrial Association (NDIA) Manufacturing Division, a broad-based representation of the U.S. defense industry, identified seven "serious manufacturing-related issues impacting the U.S. defense industry," namely:

- Manufacturing technology
- Manufacturing workforce
- DoD supply chain
- Modernization of DoD manufacturing facilities
- Globalization
- Manufacturing and local economies
- Environmental issues

In addition to giving the DoD ManTech Program high prominence in its paper, the NDIA sent arguably its strongest message when it stated, "if we lose our preeminence in manufacturing technology, then we lose our national security."[6]

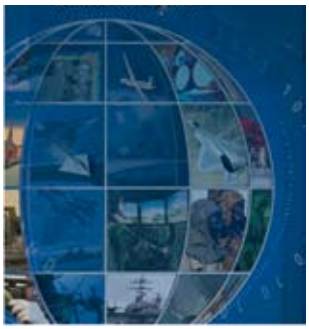
The effectiveness of the DoD ManTech program bears directly on how well the Department affordably equips and readies its warfighters, and the next section presents ManTech's key roles and responsibilities within this challenging strategic context.

6 National Defense Industrial Association (NDIA) Manufacturing Division, "Maintaining a Viable Defense Industrial Base" (August 1, 2008), p. 3.

III. MANTECH'S ROLE WITHIN THE DEFENSE MANUFACTURING ENVIRONMENT

…ManTech can address critical development, acquisition and sustainment problems associated with advanced weapon systems. The program impacts all phases of acquisition, facilitates technology transition, has demonstrated significant reductions in cost and cycle time, increases reliability, and has demonstrated tremendous return on investment.

- Defense Science Board 2006 Task Force Report on the Manufacturing Technology Program



This section addresses the important role of the DoD ManTech Program, underscored by the Defense Science Board's statement. ManTech's charter and its span of influence across the defense system life cycle uniquely position the program to be a tool of major importance for DoD acquisition leadership. While ManTech cannot single-handedly solve the challenges of defense manufacturing in the 21st century, it can serve as a focal point to bring attention and technological resources to bear on the Department's most pressing needs for modernization and sustainment.

A SHARED VISION

Defense Manufacturing Vision:

A responsive, world-class manufacturing capability to affordably and rapidly meet warfighter needs throughout the defense system life cycle

The ManTech Program shares an expansive vision that resides, in essence, at a level *above* ManTech, because it is the focus of all of defense manufacturing; that is, *a responsive, world-class manufacturing capability to affordably and rapidly meet warfighter needs throughout the defense system life cycle*. Simple yet powerful, this vision captures the overriding imperative to satisfy warfighter requirements across the spectrum of manufacturing activities–in all phases of research, development, and acquisition, and through support and sustainment–including the stipulation that those needs be satisfied *affordably* and *rapidly.* For example, in the weapon system design and development phase, ManTech supports the vision by enabling virtual evaluation of multiple design options, fostering rapid design for low life-cycle cost and low variability manufacture, and maturing needed process capabilities to acceptable and quantified risk levels. In the production phase, ManTech can help enable rapid, low-cost, high-quality manufacturing; efficient factory operations and supplier interactions; and the decoupling of unit cost from production volume. In the support and sustainment phase, ManTech advancements can lead to more efficient repair processes; rapid, low-cost spares and replacement parts acquisition; and efficient maintenance, repair, and overhaul operations. Congress has long recognized this essential, enabling role, which is detailed in what follows.

The Manufacturing Technology Program is founded in Section 2521 of Title 10, United States Code (10 USC 2521); namely:

"[T]o further…national security objectives…through the development and application of advanced manufacturing technologies and processes that will reduce the acquisition and supportability costs of defense weapon systems and reduce manufacturing and repair cycle times across the life cycles of such systems."

The DoD ManTech program, formalized within the Department by DoD Directive (DODD) 4200.15, requires vigorous collaboration between the governmental and non-governmental manufacturing components of the defense industrial base, the Military Department S&T and weapon system communities, defense sustainment and logistics organizations, and academia.

THE DOD MANTECH PROGRAM MISSION

ManTech Mission:

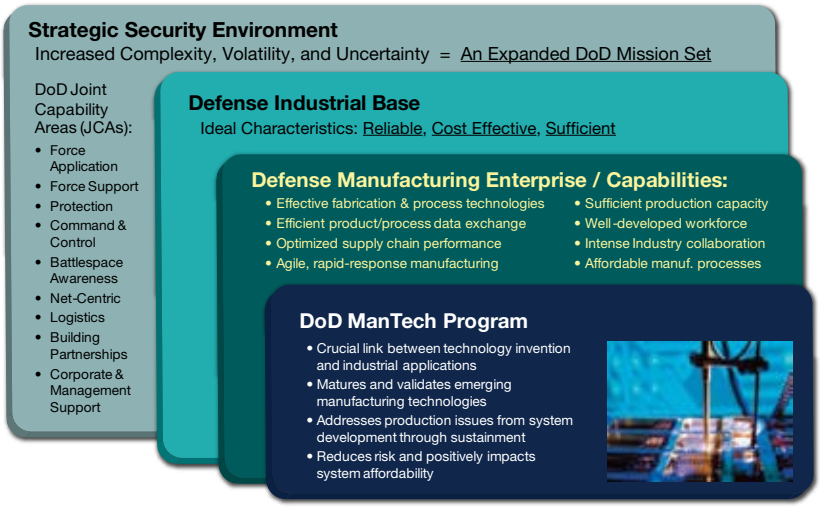
ManTech anticipates and closes gaps in manufacturing capabilities for affordable, timely, and low-risk development, production, and sustainment of defense systems.

The program's mission, therefore, is multi-faceted and vital; namely, *DoD ManTech anticipates and closes gaps in manufacturing capabilities for affordable, timely, and low-risk development, production, and sustainment of defense systems.* The program looks beyond the normal risk of industry and directs investments at improving the quality, productivity, technology, and practices of businesses and workers providing goods and services to the DoD. DODD 4200.15 further defines this essential, continuing mission, requiring the ManTech Program to:

- Aid in the economical and timely acquisition and sustainment of weapon systems and components
- Ensure that advanced manufacturing processes, techniques, and equipment are available for reducing DoD material acquisition, maintenance and repair costs
- Advance the maturity of manufacturing processes to bridge the gap from research and development advances to full- scale production
- Promote capital investment and industrial innovation in new plants and equipment by reducing the cost and risk of advancing and applying new and improved manufacturing technology
- Ensure that manufacturing technologies used to produce DoD materiel are consistent with safety and environmental considerations and energy conservation objectives
- Provide for the dissemination of program results throughout the Industrial Base
- Sustain and enhance the skills and capabilities of the manufacturing work force, and promote high levels of worker education and training

ManTech's role as a crucial link between technology inventions and industrial applications gives the program a unique and vital position within the defense industrial base and broader strategic security environment. Further, the GAO has concluded in successive annual weapon system reviews that entering production with immature manufacturing capabilities is a significant contributing factor to cost and schedule overruns (see Section II). The ManTech Program's core focus on closing manufacturing technology capability gaps is therefore an important part of the Department's solution to its growing affordability and acquisition timeliness challenges.

Closing gaps in defense manufacturing capabilities to enable technology transition gives ManTech a unique identity within the extended defense enterprise.



By its very nature, the introduction of advanced weapon systems entails the use of new product technologies that provide the performance enhancements that make the new weapon systems desirable. The ability to introduce these performance enhancements is often paced by the ability to manufacture them at an affordable cost, at an acceptable rate, and with the consistent quality that can be a matter of life and death for the warfighter. Thus the maturing of manufacturing processes and equipment in parallel with the maturation of the product technology is vital if advanced weapon systems are to be fielded on-time, at an affordable cost, and with the desired mission performance capability. Advancement of manufacturing technology–the central focus of the ManTech Program–is thus essential to the introduction of advanced weapon system capabilities.

While defense weapon systems increasingly draw on components where the newest technology resides in either commercial or foreign suppliers, there are still many key technologies where defense needs are driving the product technology. Advanced turbine engine technology is a case in point. In this area, commercial use of advanced engine components typically lags military use by 5-10 years. Thus a continuing strong focus on improving the efficiency of domestic defense suppliers is vital now and for the future and will continue to be a mainstream ManTech activity.

Recognizing the potential for defense manufacturing and ManTech to have a pivotal impact on defense system affordability and rapid delivery, the USD(AT&L) identified Manufacturing Technology as a focus area within USD(AT&L) Strategic

Goal 3, "Focused Technology to Meet Warfighting Needs," in its Strategic Goals Implementation Plan. The specific sub-goal is 3.1.4: "Promote and shape investments to lower costs and development time for the enterprise."[7] The ManTech strategic goals and objectives in this plan align and unify the ManTech community to attack this focus area broadly and aggressively. The DoD 2007 Research and Engineering Strategic Plan[8] helps to further demonstrate ManTech's cross-cutting value in attacking the challenges of affordability and timely delivery. ManTech occupies a prominent, central position as a crosscutting program necessary for enabling technology and disruptive capabilities. Figure 3, an excerpt from the DoD Research & Engineering (DoDR&E) Strategic Plan summarizing "Desired Capabilities S&T Investment Areas," graphically reinforces this.[9]

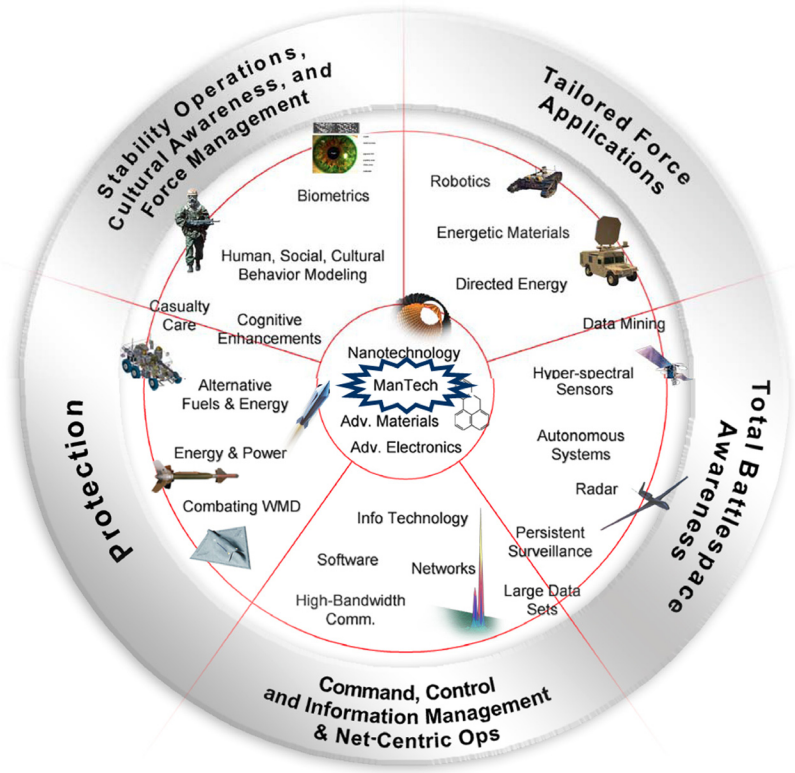


Figure 3. DoDR&E Strategic Plan S&T Investment Areas

7 USD(AD&L) Strategic Goals Implementation Plan, Version 3.0 (2009), p. 62.

8 Developed by the office of the Director of Defense Research and Engineering (DDR&E)

9 See 2007 DDR&E Strategic Plan, p. 20.

The ManTech Program's activities not only cross multiple organizational boundaries within the Defense Department, including the Military Departments, Defense Logistics Agency (DLA) and Missile Defense Agency (MDA), but they also span the entire defense industrial base, including prime contractors, subcontractors, suppliers, hardware and software vendors, industry consortia, manufacturing centers of excellence, colleges and universities, and research institutions. The DoD ManTech community also works closely with other federal agencies, including the Department of Commerce (DoC), the Department of Energy (DoE), the National Science Foundation (NSF), and the Department of Homeland Security (DHS).

MANTECH TENETS

When viewed in the aggregate, ManTech's charter is broad, but its budget is limited. Recent, program-wide annual budget submissions have hovered around $200 million (approved Fiscal Year 2009 appropriations totaled slightly over $275 million), or about two percent of DoD S&T funding.[10] A disciplined, integrated, and prioritized strategy is thus necessary to develop policies and apply resources–financial, human capital, infrastructure, and intellectual property–to best meet its mission. ManTech applies the following four tenets to help establish priorities:

ManTech Tenets:
Guides for making sound policy and resource allocation decisions

1. Address the highest priority defense manufacturing needs in the window of opportunity to make a difference.
2. Transition manufacturing R&D processes into production applications.
3. Attack pervasive manufacturing issues and exploit new opportunities across industry sectors.
4. Address manufacturing technology requirements beyond the normal risk of industry.

These tenets are the program's guides for making sound policy and resource allocation decisions. While these tenets are extremely useful in this regard, it is equally important that the DoD ManTech Program be properly organized to oversee, execute, and coordinate these essential policy and resource allocation functions across the Department. These organizational facets are discussed next.

10 Consolidated Security, Disaster Assistance, and Continuing Appropriations Act, 2009, P.L. 110-329.

MANTECH PROGRAM GOVERNANCE

ManTech Program governance consists of:
- *OSD Policy and Oversight*
- *Joint Coordination of Technology Portfolios*
- *Component Level Execution*

Section 2521 of Title 10, United States Code, requires the USD(AT&L) to administer the DoD ManTech Program on behalf of SecDef. The DoD ManTech Program today is administered for the USD(AT&L) by the office of the Deputy Under Secretary of Defense for Advanced Systems and Concepts (ODUSD(AS&C)), which exercises OSD-level oversight, on behalf of the DDR&E, the USD(AT&L), and SecDef. Component ManTech Programs are individually executed by the Army, Navy, Air Force, and DLA (MDA and DARPA oversee related but unique activities[11]). These component programs collaborate and coordinate their efforts through a collective body called the Joint Defense Manufacturing Technology Panel (JDMTP). The JDMTP operates under a charter signed by the Director of Defense Research and Engineering (DDR&E) and the S&T Executives of the Army, Navy, Air Force, and DLA. This organizational construct is depicted in Figure 4 and is addressed in more detail in Annex C.

The Deputy Under Secretary of Defense for Advanced Systems and Concepts administers and oversees the DoD ManTech Program on behalf of the SecDef and USD(AT&L), with primary program execution at the component level, and cross-component coordination via the JDMTP.

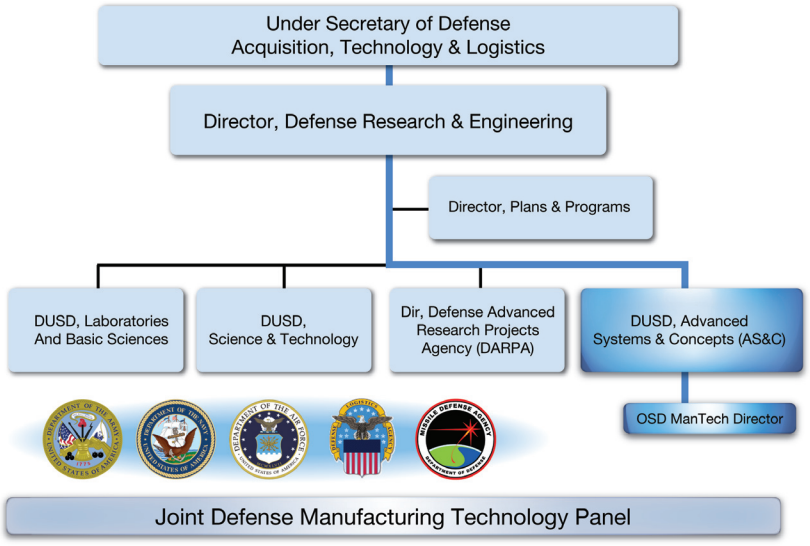


Figure 4. DoD ManTech Program Organizational Construct

11 Although the Missile Defense Agency (MDA) and Defense Advanced Research Project Agency (DARPA) do not manage traditional ManTech programs as defined by 10 USC 2521, their interplay with defense manufacturing drive separate and unique relationships with the DoD ManTech program. The MDA maintains a "Producibility and Manufacturing" office under the organization's Deputy for Engineering, Producibility, and although MDA is not formally recognized as a ManTech component in current program governance documents, it is a de facto component member. Though focused primarily on advanced product (versus manufacturing) technology, DARPA's innovation and development of new products drives multiple interplays with manufacturing technology, and therefore DARPA is recognized as an ex-officio member of the DoD ManTech program. Additional detail can be found at Annex C.

The Principals of the JDMTP are senior technology managers representing the Army, Navy, Air Force, DLA, and MDA. OSD is represented as an ex-officio member of the panel to provide the communication link to OSD as well as in the capacity of manager of the DoD Manufacturing Science & Technology (MS&T) portion of ManTech. As detailed in Annex C, MS&T is the DoD leadership's response to the 2006 DSB Report recommendation to establish such a program, and it addresses cross-cutting, game-changing initiatives that are beyond the scope of any one Military Department or Defense Agency. The JDMTP (see Figure 5) serves to communicate component ManTech initiatives across traditional component program boundaries, thus providing an inter-agency/joint service environment for collaboration and coordination in advanced manufacturing technologies and processes. The JDMTP organizes ManTech investment areas by technology portfolios managed by subpanels–the current subpanels are Electronics, Metals, and Composites–enabling component ManTech programs to maximize opportunities for shared investment in initiatives and strategies with joint application, and to minimize duplication of effort.

JDMTP Coordination is the "life blood" of ManTech Program cross-component coordination activities.

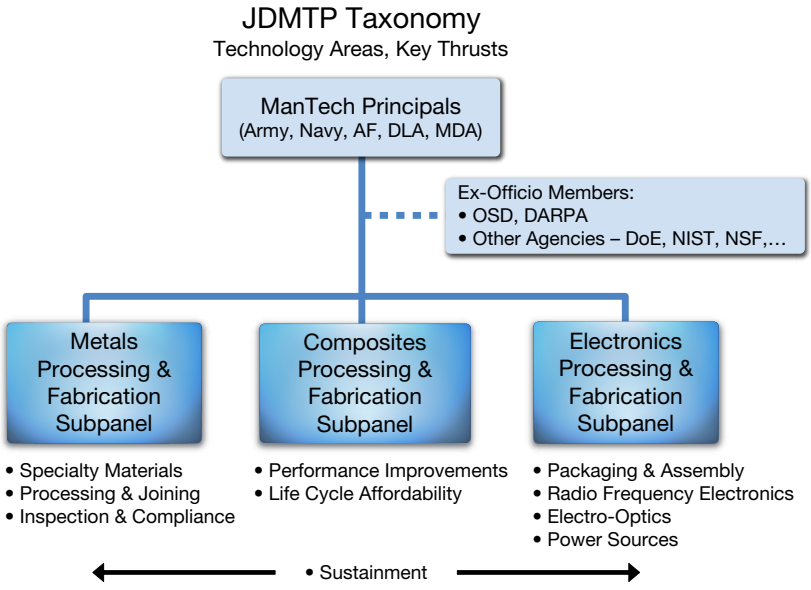


Figure 5. JDMTP Taxonomy

This JDMTP coordination represents the "life-blood" of the ManTech Program's cross-component activities. The JDMTP is also the defense industry's DoD touch-point on most manufacturing R&D matters, facilitating routine departmental

interactions with the manufacturing industry as well as large events like the annual Defense Manufacturing Conference, with recent attendance at about 1,000 participants. Additional details are provided at Annex C.

MANTECH PROGRAMMING AND EXECUTION

The Military Departments and participating Defense Agencies execute ManTech's major programmatic activities in support of unique and vital component focus/ thrust areas.

Major program element (PE) programming and execution occurs at the Military Department and Defense Agency level (OSD manages the DoD MS&T PE) and is overseen and managed within the S&T organizational structures of each participating component. Though all component ManTech programs work in concert towards common goals, each have important focus areas to meet individual Service and Agency needs. Currently, the central focus for Army ManTech investments is reduction of cost and risk for production of the Army Future Combat System (FCS) and other Future Force systems. A secondary thrust is the affordable transition of new technologies which can enhance capabilities of the current force. The Navy's critical goal is to reduce the acquisition cost of current and future platforms. As a result, Navy ManTech has adopted a "shipbuilding affordability" investment strategy and is currently focused on affordability improvements for four major acquisition platforms: DDG 1000, CVN 21, the Littoral Combat Ship (LCS), and the VIRGINIA Class Submarine (VCS). Air Force ManTech strives for a balanced investment mix across air, space, and cyberspace systems, but in the near term a particular focus is on advanced propulsion, stealth, and sensors for fighter and strike systems. The DLA ManTech Program supports the organizational mission to provide the processes to sustain the warfighters and their materiel; ongoing efforts support improvements in troop rations, as well as forging and castings. Missile Defense Agency manufacturing efforts are focused on the transition of processes to enable the production of missile defense material. Finally, the DoD MS&T Program takes a broad, overarching view towards closing critical gaps in cross-cutting, military manufacturing enabling technologies.

While ManTech investments produce a wide spectrum of benefits meeting Military Department, DoD Agency, and overall Department needs, cost savings and cost avoidance reflect the common "affordability" thread and focus of all components. A recent report to Congress identified over 100 projects funded by ManTech in FY03 to FY05 that have resulted in implementations yielding a cost

A recent report to Congress identified over $6.3 billion in cost avoidance benefits driven by ManTech implementations from projects funded during FY03-FY05.

avoidance of more than $6.3 billion.[12] Implementations from ManTech projects continue to improve affordability, highlighted by the following recent examples:

- Army ManTech advancements in phased array antennas carry a projected cost savings of $134 million over ten years. A Ballistic Protection project resulted in a return on investment (ROI) of 7.7 to 1 with a cost benefit of $327 million.
- Recent Navy ManTech platform affordability projects have realized cost savings of $6.5 million per hull for the VIRGINIA Class Submarine, with potential additional savings of $30 million per hull.
- Investing $9.6 million, Air Force ManTech created a projected cost savings of $760 million for current generation active electronically scanned array radars. Investments in Alternate High Frequency Material scale-up allowed the B-2 to replace an problematic older technology resulting in doubling of mission capable rates and halving of maintenance man-hours per flying hour.

ManTech continues to generate significant and tangible cost savings and cost avoidance benefits for the Department.

- The Defense Logistics Agency has recognized that the key to affordably sustain older weapon systems is locating the unique process knowledge and expensive tooling owned by lower tier defense suppliers. Working with the Forging Industry Association, the Non-Ferrous Founders Society, and commercial software developers, DLA's tooling databases for castings and forgings now hold tens of thousands of tooling locations from hundreds of companies. This information is used in the procurement of over $1M per month of DLA spare parts procurements and prevents costly backorders.
- The Missile Defense Agency invested $20 million in a Throttleable (versus Solid) Divert Attitude Control System (TDACS versus SDACS). TDACS uses common aerospace materials and a modular, scalable design to demonstrate a producible, low cost propulsion system and reduce overall program risks for the Navy's Standard Missile-3 program.
- The MS&T Program's Network Centric Manufacturing Project, using net-centric approaches to capture manufacturing process knowledge, demonstrated significant (58%) engineering time savings required for critical spares for the M2 Machine Gun, widely used by U.S. and NATO forces.

12 Report to Congress on Implementation of DoD ManTech Projects Receiving FY03-FY05 Funds. Department of Defense. Office of the Under Secretary of Defense for Acquisition, Technology and Logistics. 2008

These significant cost savings from recent programs underscore the power of ManTech contributions to defense affordability needs, ultimately benefitting the warfighter. Annex C provides descriptions of each Military Department and Defense Agency program and the DoD MS&T program and describes each component's organizational structure, focus/thrust areas and investment strategy, specific initiatives, program review process, and investment profile.

MANTECH PROGRAM FUNDING

Figures 6 and 7 reflect congressionally appropriated aggregate funding, in both then-year and constant-year (2007) dollars, respectively, over the past 18 years managed by all components of the DoD Manu facturing Technology Program, plus current funding projections.

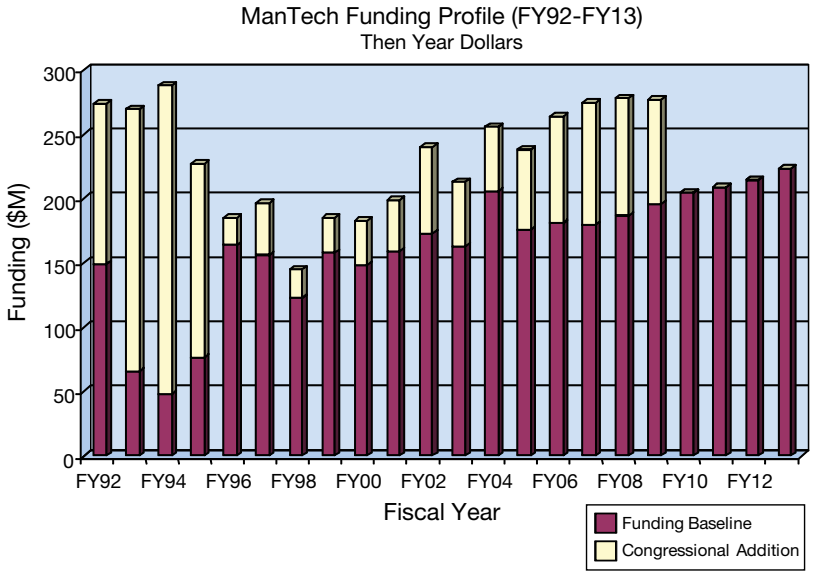


Figure 6. ManTech Program Funding Profile (Then-Year Dollars)

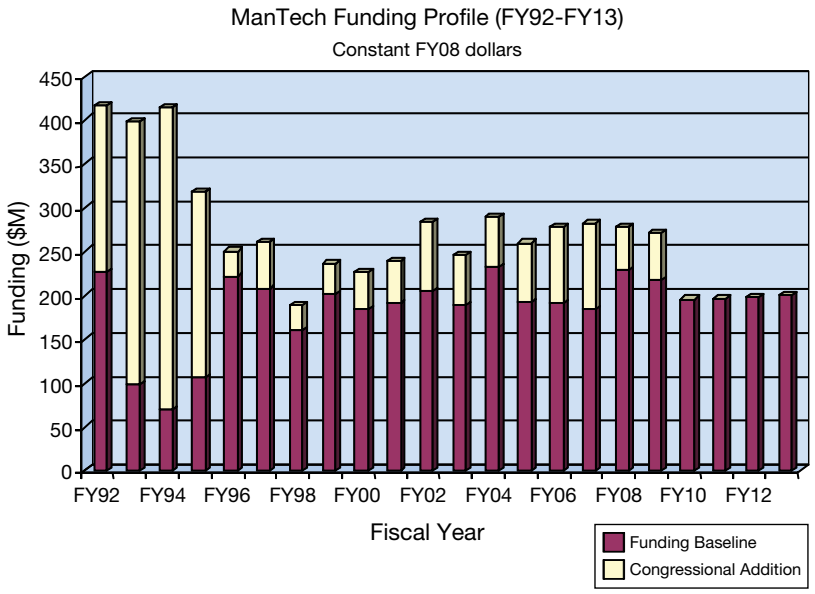


Figure 7. ManTech Program Funding Profile (Constant-Year Dollars)

Additionally, Table 1 identifies the Military Department, DoD Agency, and OSD ManTech program elements and budget for FY09 through FY13. The FY09 figures represent the appropriated amounts from PL 110-329, and the FY10-FY13 figures represent the FY09 President's Budget (PB) submission.

Table 1. ManTech Program Funding, by Program Element (Dollars, in Millions)

PROGRAM	FY09 Approved	FY09 PB			
		FY 10	FY 11	FY 12	FY 13
DoD MS&T (PE 0603680D8Z)	18.4	14.9	19.9	19.9	24.8
Army ManTech (PE 0708045A)	91.1	69.6	70.2	71.7	73.4
Navy ManTech (PE 0708011N)	61.9	58.6	56.5	60.0	60.6
AF ManTech (PE 0603680F)	56.5	40.5	40.8	41.6	42.5
DLA ManTech (PE 0708011S)	55.3	20.8	21.3	21.7	22.0
MDA* (PE 0603890 YX29)	33.3	38.6	47.6	44.8	45.5
TOTAL**	283.2	204.4	208.7	214.9	223.3

* MDA line is the total for all Manufacturing and Producibility

**This total does not include MDA's budget for Manufacturing and Producibility

Maintaining stable, predictable, and sufficient investment levels across all program elements is necessary to minimize ManTech Program turbulence and enable it to meaningfully impact defense system development, acquisition and sustainment needs. The next section presents the framework of strategic thrusts and enabling goals designed to optimally couple these resources with all ManTech program investment decisions in support of this critical Department mission.

IV. A FRAMEWORK TO MAXIMIZE MISSION EFFECTIVENESS – THE MANTECH PROGRAM'S STRATEGIC THRUSTS AND ENABLING GOALS

THE MANTECH PROGRAM'S STRATEGIC THRUSTS

Given the magnitude of defense manufacturing needs, the DoD ManTech Program is careful to focus and apply its relatively small investment footprint within the Department for maximum effectiveness. The following four program strategic thrusts have been established to accomplish this, consistent with the Defense Manufacturing vision statement and ManTech mission:

The DoD Manufacturing Technology Program is guided by four strategic thrusts.

- **Thrust 1:** *Effective Management and Delivery of Processing and Fabrication Technology Solutions*
- **Thrust 2:** *Active Support for a Highly Connected and Collaborative Defense Manufacturing Enterprise*
- **Thrust 3:** *Active Support for a Strong Institutional Focus on Manufacturability and Manufacturing Process Maturity*
- **Thrust 4:** *Active Support for a Healthy, Sufficient, and Effective Defense Manufacturing Infrastructure and Workforce*

This configuration balances ManTech's core requirement to effectively deliver material processing and fabrication technology solutions (Thrust 1) with the statutory obligation to actively support broader defense manufacturing enterprise

needs (Thrusts 2, 3, and 4). The latter three of these strategic thrusts reflect the importance of program support for these broader needs while recognizing it is beyond the program's charter and resources to *fully* satisfy them.

This balanced arrangement of strategies is key, given that: (1) there is no single, centralized champion for defense manufacturing in OSD below the USD(AT&L) level;[13] (2) the ManTech Program, given its cross-cutting nature, impacts or is impacted by almost all defense manufacturing issues facing the Department; and (3) there is a symbiotic relationship between the Strategic thrusts, e.g., the ability of the ManTech Program to achieve the program's enabling goals[14] within Thrust 1 is directly related to how well the enabling goals within Thrusts 2, 3, and 4 are achieved.

The "reach" of the DoD ManTech Program extends beyond its primary and core focus on enabling processing and fabrication technology solutions (Thrust 1), requiring active support for other, strategic needs across the defense manufacturing enterprise.

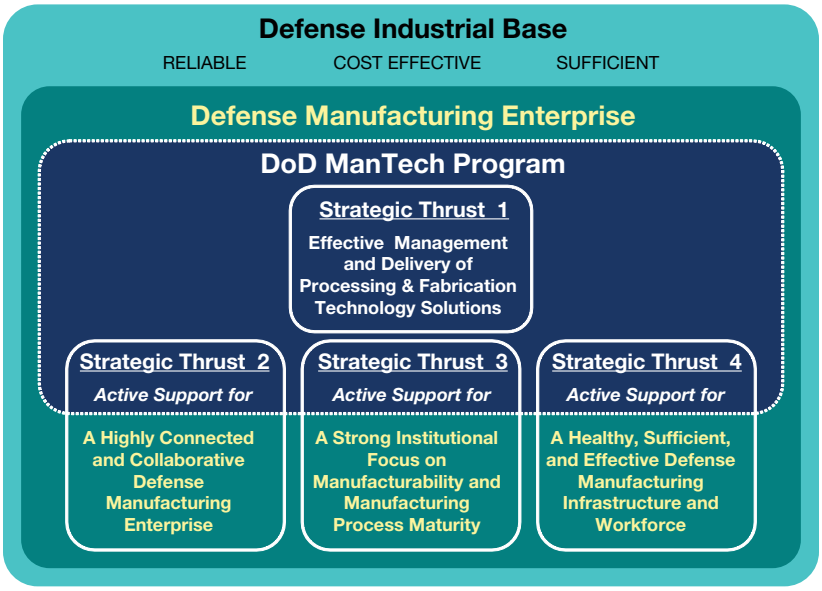


Figure 8. The DoD ManTech Program's Strategic Thrusts

Figure 8 graphically depicts the program's four strategies, including the unique positioning of its three, outward-looking "support" strategies (Thrusts 2, 3, and 4). This collective set of strategies helps to foster the necessary levels of

13 Primary defense manufacturing responsibilities are shared by several offices within DDR&E (including the ManTech office within DUSD(AS&C)'s Office of Technology Transition), DUSD(A&T)'s Industrial Policy and Systems & Software Engineering offices, and various DUSD(L&MR) interests, among others.

14 Enabling goals are presented later in this section.

coordination and collaboration across the Department, industry, academia, research institutions, and other governmental agencies. This increased connectedness and collaboration enables a strong, enterprise-wide focus on manufacturability and manufacturing process maturity as well as a more unified effort to sustain a sound defense manufacturing infrastructure and workforce, all of which serve to enhance ManTech's core program performance (Thrust 1) and its impacts on affordability, timely delivery, and sustainment of defense systems.

The full suite of available policy, outreach, and strategic communications tools should be brought to bear in support of all four strategic thrusts.

Planning to support the collective health of these four strategies includes:

- Coordination and development of departmental and component policies and legislative recommendations
- Partnering activities, both internally as well as externally across the interagency, industry, and academia
- Subject matter expert participation in various initiatives
- Other outreach and strategic communication efforts

The following paragraphs define each of the strategies in more detail and present the ManTech Program's enabling goals supporting each strategy. These goals serve to "operationalize" each strategic thrust by introducing sufficient definition to enable focused action by component programs via supporting plans and roadmaps.

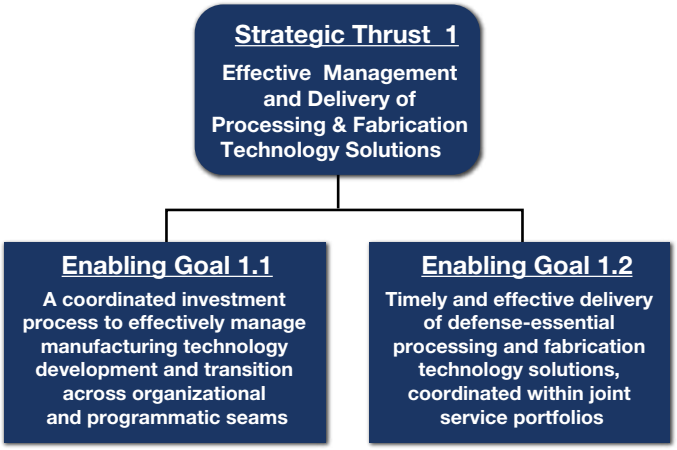
Strategic Thrust 1
Effective Management and Delivery of Processing & Fabrication Technology Solutions

Strategic Thrust 1: *Effective Management and Delivery of Processing & Fabrication Technology Solutions*

This strategic thrust in many ways represents the core activity of the DoD ManTech Program. It most directly maps to the program's mission statement, and ManTech is the only DoD program that addresses this activity as its primary objective. This strategic thrust thus assumes a certain primacy and can appropriately be considered the program's "delivery strategy." The key, direct-line recipients or customers of these delivered manufacturing technology solutions are the acquisition and logistics program managers responsible for transitioning acquisition programs from development into production and for the repair, maintenance, and overhaul of fielded systems, as well as multiple manufacturing stakeholders across the broader defense industrial base. Sustained attainment of the enabling goals within this strategic thrust most directly reflects ManTech program success. This thrust therefore drives the vast majority of program investment activity, from requirements determination, to

Thrust 1 is the program's core, "delivery" thrust area.

prioritization of ManTech proposals and projects, to ManTech project selection and follow-through. Strategic Thrust I is supported by two enabling goals that are focused, respectively, on continuous improvement of the *management* (Goal 1.1) and *execution* (Goal 1.2) of ManTech processing and fabrication investment activity. These enabling goals are presented next.



Enabling Goal 1.1 underscores the importance, and challenge, of managing all programmatic and organizational interfaces to maximize return on ManTech investments.

Enabling Goal 1.1: *A coordinated investment process to effectively manage manufacturing technology development and transition across organizational and programmatic seams.* This goal, in support of ManTech's core delivery strategy, recognizes the complexity of the multiple organizational and programmatic interfaces across which increasingly maturing manufacturing technologies need to be managed. This applies to all categories and phases of research, development, acquisition and sustainment. The objective is the continuous improvement of a coordinated management process that helps ensure the ManTech Program's adaptability and resilience, and provides an environment which enables successful manufacturing technology transition. The diagram in Figure 9 provides a high-level framework establishing a common, integrated operating picture that the JDMTP and the ManTech component programs–including OSD-managed MS&T activities–should collectively operate within and seek to continuously improve. The framework depicts the major attributes of the three-phase process of (1) ManTech requirements determination, (2) identification and prioritization of strategic initiatives and projects, (3) and project selection and execution; both *within* programs and organizations and *across* their boundaries. The degree to which investments are effectively coordinated and managed within this framework is the measure of Goal 1.1's success. Although this goal is assigned to Thrust 1, this model can and should

also be applied to any ManTech investment activity supporting Strategic Thrusts 2, 3, and 4. An additional element of this management process should include an organization and charter review of the JDMTP on some recurring basis, possibly associated with the cycle of recurring updates to this plan. This review would ensure that the JDMTP is properly organized to manage critical technology portfolios, establish roadmaps, and review defense-wide requirements.

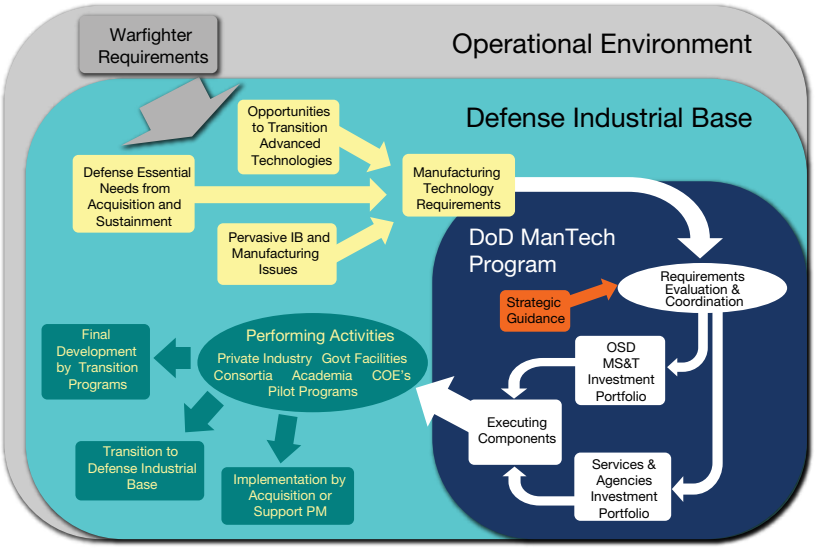


Figure 9. ManTech Investment Process

A disciplined investment process, including careful and integrated investment management across all organizational and programmatic "seams" or interfaces, enables smooth transition and implementation of each critical manufacturing technology element.

Enabling Goal 1.2 is ManTech's key operational and technical goal.

Enabling Goal 1.2: *Timely and effective delivery of defense-essential processing and fabrication technology solutions, coordinated within joint service portfolios.* This goal represents the operational management and technical execution of the core ManTech program, guided by the investment process outlined in Goal 1.1, and described in detail via JDMTP and Military Department/DoD Agency ManTech policy and process documents. Technology portfolios are developed and managed by the program components using manufacturing roadmaps, analyses of defense system affordability drivers, and DoD customer determined priorities. They are coordinated by JDMTP joint-service technical subpanels (currently Composites, Electronics, and Metals–see Annex B). A high degree of joint-service planning within each portfolio increases leverage across Military

Departments and DoD Agencies while preserving component priorities. Inherent to this goal is the delivery of solutions that follow defense priorities crossing technical boundaries, such as "green manufacturing," focused on meeting energy security objectives by reducing energy demands, using alternative energy sources, and meeting future environmental compliance policies.

Composites thrust area portfolio

Current and emerging thrust areas for composites:

- ***Transparency / Low Observables***
- ***Armor***
- ***Structures***
- ***Marine composites***
- ***High temperature applications***

Key investment topics within the composites area include structural composites, marine composites, and high temperature composites. High temperature ceramic matrix composites will enable dramatic weight and fuel savings for turbine engines. Marine environments require special processes applied to thick sections to enable shipboard applications. Structural composites processing is divided into lightweight aerospace-grade structures with complex geometry and multi-layer combat-vehicle structure with ballistic protection. Aerospace structural composites enable rotorcraft performance improvement and maintenance reduction. Recent composites successes include:

- ManTech's lightweight tail cone structure, transitioned to the Acquisition Manager for Blackhawk production, significantly reduced weight, enabling increased sortie generation and fly times.
- ManTech's recently approved Propulsion Shaft Composite Surface Treatment coating process provides corrosion protection for 14 years. This is twice as long as the baseline coating and provides the ability to extend the interval between required drydock maintenance periods.
- An innovative stitched resin infused manufacturing process was developed and transitioned to eliminate maintenance issues for the C-17 main landing gear doors. In addition to decreased manufacturing and installation costs, the improved doors are expected to provide an increased fleet readiness level of approximately 90 days per year.

ManTech composites initiatives will continue to aid the warfighter in significant ways, and Annex C provides additional detail on the composites thrust area.

Electronics thrust area portfolio

Current and emerging thrust areas for electronics:
- *RF devices*
- *Power and energy*
- *Infrared/Electro-Optics (IR/EO)*
- *Nanotechnology*
- *Sensors*
- *Packaging*

Key investment topics for electronics include wide bandgap and silicon carbide (SiC) devices, lithium ion (Li-Ion) batteries, advanced packaging and fabrication technologies, and micro and flexible display technologies. Wide bandgap and SiC devices provide a substantial reduction in size, weight, and power for critical items such as radar, electronic warfare, and shipboard power. Li-Ion batteries have been identified as an enabling technology for the Army's Future Combat Systems as well as space applications for the Missile Defense Agency. Advanced Electronics Packaging and Fabrication will provide reductions in cost, weight, and size of electronics through such efforts as Integrated MEMS Packaging for the Air Force and System-on-Chip modules for the Navy. New micro and flexible display technologies will help enable the future force warrior through reduced weight and power requirements. Noteworthy electronics successes include:

- ManTech recently identified and reduced manufacturing related cost drivers for the F-22 and F-35 radar systems, reducing the costs by nearly $760 million.
- Advancements in Lithium-ion battery manufacturability are currently underway and are projected to reduce Future Combat System costs by $121 million.

See Annex C for a full description of current and emerging electronics initiatives.

Metals thrust area portfolio

Current and emerging thrust areas for metals:
- *Advanced materials*
- *Advanced/Intelligent machining*
- *Joining*
- *Castings and forgings*
- *Post processing (for example., hipping for high-strength steel castings)*

Key investment areas for metals spans material processing, castings and forging, and joining. Critical application areas include ballistic armor, affordable vehicle components, and lightweight, thin-walled structures. Materials processing includes affordable titanium power metals for FCS, composite overwrap for lightweight canon tubes, and developing substitutions for older qualified alloys which are out of production. Casting and forging processes include advanced modeling to increase performance, tooling databases, and modeling lightweight alloys. Joining and advanced machining are required both for next generation systems design and to support out of production legacy systems. Intelligent machining initiatives will transform the supplier network capabilities and thus impact almost all defense systems acquisition. Recent metals successes:

- ManTech improved the high-strength, low-alloy steel being used in CVN 78 Class aircraft carriers. This improved steel reduces carrier weights by 100-200 long tons. Ongoing work in the area of welding and joining processes will continue to drive down carrier costs.
- The ManTech-developed National Forging Tooling Database locates legacy forging dies on a regular basis, dramatically reducing both lead times and cost. The digital reference image standards for aluminum and steel castings, which ManTech also sponsored, reduces inspection times by up to 75%.

Significant opportunity for ManTech leverage exists in the Metals portfolio, and a more detailed discussion of current and emerging initiatives can be found at Annex C.

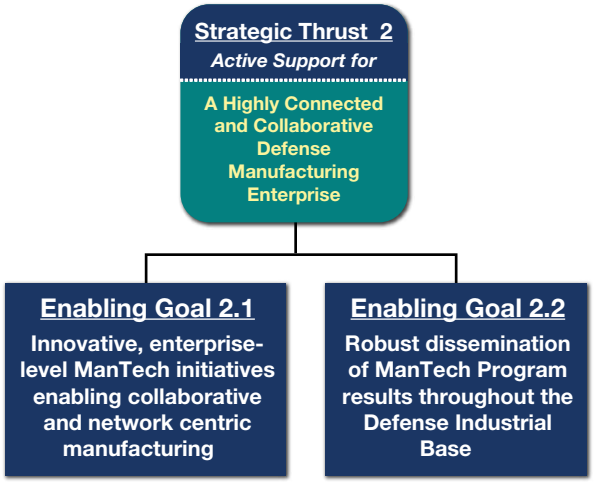
Other processing and fabrication investments to meet defense-essential needs

Emerging technical investments will not always fit within the existing Composites, Electronics, or Metals thrust area portfolios. Thus, additional working groups or formal portfolio areas should continue to be established as needed to coordinate the execution and delivery of these technical solutions.

Strategic Thrust 2
Active Support for
A Highly Connected and Collaborative Defense Manufacturing Enterprise

Strategic Thrust 2*: Active Support for a Highly Connected and Collaborative Defense Manufacturing Enterprise*

This is the first of three DoD ManTech Program strategic thrusts applying to the broader defense manufacturing base. 21st century defense manufacturing will rely on a networked, collaborative and increasingly global supply base, with capabilities that can be linked within and among the nodes to respond rapidly to dynamically changing defense needs. The cost and schedule of defense systems are driven primarily by activities that are "above the factory floor", i.e., in enterprise level processes, business practices and interactions with suppliers and with the government customer. The Department's ManTech Program has a strategic interest in the development and implementation of such enterprise capabilities; hence the need for this thrust. As suggested in the strategy's description, it contains a dynamic or interactive component ("collaborative") as well as an information dissemination component ("highly connected"). Each component of this strategy is associated with an enabling goal, discussed next.



Goal 2.1 encompasses the research, development and implementation of capabilities such as Model Based Enterprise, Network Centric Manufacturing, collaborative modeling and simulation capabilities, and best commercial practices.

Enabling Goal 2.1: *Innovative, enterprise-level ManTech initiatives enabling collaborative and network centric manufacturing.* This goal encompasses the research, development, and implementation of capabilities which allow for a highly collaborative manufacturing environment among the multiple entities in system development and production. Specific initiatives that fit within this goal include Model Based Enterprise, Network Centric Manufacturing, collaborative modeling and simulation capabilities, and best commercial practices within defense manufacturing. Each of these initiatives represents an innovative approach to enable multiple stakeholders to collaborate at the enterprise level. This collaboration takes place along each phase of a product life cycle, and between traditionally separate entities, such as the PEO, prime contractors, OEMs, and multiple suppliers. This impacts both manufacturability and producibility. While much of the burden of advancement in this area will be carried by industry, ManTech can invest where there is a clear payoff to DoD and where it is evident that ManTech involvement will accelerate progress. For the initiatives described in the following paragraphs, the ManTech Strategy may include elements of technical development, proof of concept experiments, and pilot programs.

Network-centric and collaborative manufacturing capabilities provide the structure required for a synchronized and secure defense manufacturing enterprise, with real-time visibility into both product lifecycle design data and manufacturing and support capabilities. Initiatives required to support these outcomes include a smart network architecture, sustained design and process

data management, and trustworthy analysis techniques within an extended network. The benefits from such an approach to manufacturing are speed of delivery, affordability, and increased transition of producible processes.

Model Based Enterprise (MBE) provides the collaborative design environment between engineering and design, production and test, and the manufacturing supply chain. The objectives of MBE include a highly integrated design for manufacturability capability, increased fidelity cost modeling, pre-production test and validation, and first article quality. Among the major elements required for implementation of MBE are 3-dimensional modeling, manufacturing process simulation, the use of high performance computing tools to optimize manufacturing of complex systems, verified component and process cost models, and visualization of end-to-end production and test processes. The promise of MBE is the ability to cycle through multiple design, model, and test cycles before producing the final system with confidence.

A final, but critical approach to a highly connected and collaborative defense manufacturing enterprise is the adoption and integration of commercial manufacturing practices within the defense manufacturing enterprise. This allows for the greatest leverage of existing production capabilities across industry and breaks down barriers to an affordable, responsive defense manufacturing supply chain. By allowing military products to be manufactured within required specifications using the same processes or even on the same production line as commercial products can dramatically expand the qualified domestic suppliers and provide for a highly collaborative industrial base. This practice can often result in large decreases in unit production cost.

Both robust and targeted dissemination resulting in subsequent technology transition into additional systems can transform an innovative, first-use manufacturing capability into a viable industry.

Enabling Goal 2.2: *Robust dissemination of ManTech Program results throughout the Defense Industrial Base.* This goal represents the transition path for the results of the research and development activities conducted by the ManTech program, described primarily within Strategic Thrust 1. This dissemination of information is intended to expand the implementation of program results across the Military Departments, participating Defense Agencies, and industry, thus leveraging the ManTech investment and exploiting the results across the defense industrial base. This dissemination requires intense coordination between the component ManTech programs, the executing contractor, and the initial transition program to ensure that the work is described accurately, the maturity of processes are captured, and that intellectual property

is protected. In the best case, targeted dissemination resulting in subsequent transition into additional systems can help to transform an innovative, initial manufacturing capability into a viable industry, thus benefiting all participants.

One of the primary modes of robust information dissemination is the use of web-based capabilities, including a continually refreshed DoD ManTech Program website, indexed by technology sector and featuring points of contact from all ManTech participating organizations. This website should continue to be maintained as a flexible collaboration and information-exchange vehicle containing both secure-access and public-access layers, all enabling a high degree of electronic connection across the DoD, industry, and academia. In order to protect proprietary information, contractor-owned data may be indexed by the Defense Technical Information Center (DTIC), which allows for search and access by authorized government personnel while protecting industry intellectual property.

For scheduled wide dissemination of ManTech information including project results, system affordability analyses, and forward planning roadmaps, the annual Defense Manufacturing Conference should continue to be exploited as a highly potent forum for presentations of ManTech results. Additional important dissemination outlets include industry association conferences, trade groups, and academic gatherings. Service and Agency ManTech results are also effectively leveraged for targeted transition using annual Service or Agency acquisition conferences.

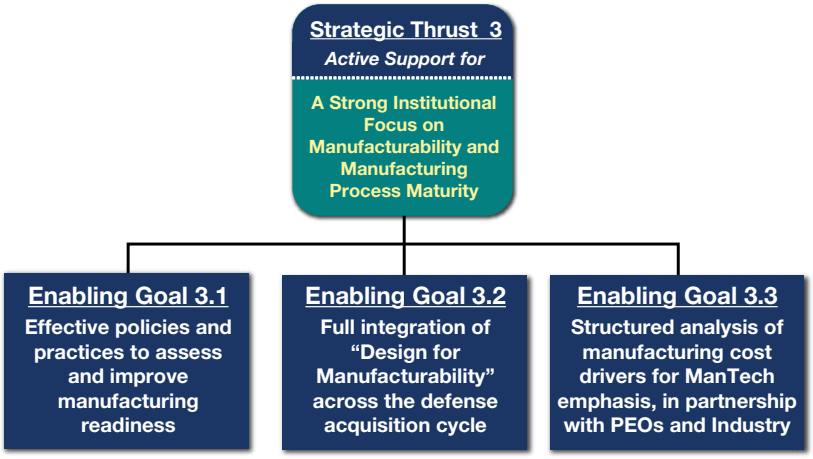
In summary, ManTech Program leadership and the broader ManTech and defense manufacturing communities must continually strive to ensure robust information exchange in support of this strategic thrust.

Strategic Thrust 3
Active Support for
A Strong Institutional Focus on Manufacturability and Manufacturing Process Maturity

Strategic Thrust 3: *Active Support for a Strong Institutional Focus on Manufacturability and Manufacturing Process Maturity*

This thrust points to the strategic need for a *pervasive culture* that embodies a cradle-to-grave focus, across DoD and industry, that persistently considers weapon system manufacturability and aggressively resolves associated production and sustainment issues over the acquisition life cycle. This goal is fully achieved only when the Defense Acquisition System properly considers

manufacturability across all research, development, and acquisition phases. This in turn maximizes opportunities to positively influence weapon system cost, schedule, and performance through manufacturing reviews appropriate for each phase of research, development and acquisition. History shows that if left unchecked and unmanaged, emphasis on manufacturability and producibility tends to "slip to the right" in a system's development, reducing opportunities to positively influence system cost, schedule, and performance. Accordingly, Strategic Thrust 3 attempts to drive a system-wide focus on manufacturing across all research, development and acquisition phases while ensuring that the central focus is sufficiently *prior* to full system production for greatest benefit. This is encouraged through several enabling goals focused on support for improvements to acquisition policy and processes, integration of Design for Manufacturability into the DoD systems engineering process, and structured analyses of cost and affordability drivers related to manufacturing.



Goal 3.1 involves the development and maintenance of a body of knowledge sufficient to support the implementation of manufacturing readiness as a management criterion.

Enabling Goal 3.1: *Effective policies and practices to assess and improve manufacturing readiness.* This goal encompasses the development and maintenance of a body of knowledge sufficient to support the implementation of manufacturing readiness as a management criterion. Manufacturing risks can be critical to an acquisition program. If not managed well, such risks can lead to significant cost increases, schedule slippage, and degraded system quality. Effective manufacturing risk assessments, sustained by a strong institutional focus on manufacturing readiness, provide a sound basis for program managers to take risk reduction actions to avoid these impacts. Full implementation requires a validated scale of Manufacturing Readiness Levels (MRLs), an assessment process, and subject matter expertise to assist in performing

manufacturing readiness assessments. Specific initiatives supporting this goal include:

- Oversight of a DoD industry working group to maintain and refine the manufacturing readiness body of knowledge, in partnership with systems engineering and DDR&E.
- Partnering with Defense Acquisition University (DAU) to provide effective MRL/MRA training for the S&T and Acquisition workforce while continuing to provide manufacturing readiness training for S&T and Acquisition professionals.
- Designation of a 1-3 year period of study and defined criteria to assess effectiveness of MRA/MRL policy and degree of implementation.

Design for Manufacturability requires partnership with the technical community in combination with standardized practices appropriate for DoD and industry.

Enabling Goal 3.2: *Full integration of "Design for Manufacturability" across the defense acquisition cycle.* This goal embodies the overarching objective of a strong institutional focus on "manufacturability" across the full defense acquisition framework. The full integration of Design for Manufacturability (DFM) requires partnership with the government and industry technical community in combination with standardized practices appropriate for DoD and industry. The ManTech community must engage with and support the DoD systems engineering community to document, promulgate and train practitioners in implementing best practices for DFM, including the importance/value of systematically considering manufacturability and producibility throughout materiel and weapon system life cycles. ManTech and systems engineering should strive for a consensus on the best method of DFM involvement for each technical review throughout the entire technology development cycle. A primary support role for ManTech should be to collect an effective DFM toolset applicable to early development phases as well as the commonly available toolset for detailed design activities. Full integration of DFM will improve the confidence level of cost estimation.

Identification of high-leverage ManTech investment opportunities is critical both for project prioritization and broad transition of results across multiple systems.

Enabling Goal 3.3: *Structured analysis of manufacturing cost drivers for ManTech emphasis, in partnership with PEOs and industry.* This goal addresses the need to understand the highest priority opportunities for targeted manufacturing cost reduction, both within major defense systems and across multiple product lines. While a structured analysis of cost and affordability drivers for major weapon systems cannot be conducted without active support from PEOs and industry, the parametric cost estimates used by most major weapon systems are only a starting point. These cost estimates may be further

analyzed for specific manufacturing process improvements, which can have a substantial impact.

An element of this goal is to analyze multiple weapon systems for systematic manufacturing cost drivers, which can identify key ManTech investment opportunities. A case in point is electronic components within antenna arrays. These arrays are used in several systems across Military Departments and Defense Agencies, and each array contains up to 5,000 similar electronics components. While a single system or ManTech program component may not be able to fund an improved manufacturing process, these meet the cost drivers criteria for a ManTech investment. Identification of these opportunities is critical both for project prioritization and broad transition of results across multiple systems.

Strategic Thrust 4
Active Support for
A Healthy, Sufficient, and Effective Defense Manufacturing Infrastructure and Workforce

Strategic Thrust 4: *Active Support for a Healthy, Sufficient, and Effective Defense Manufacturing Infrastructure and Workforce*

While the DoD ManTech Program is not structured to be solely responsible for meeting these broader industrial base needs, Strategic Thrust 4 is a vital enabler for a highly effective defense manufacturing enterprise, and DoD policy requires that the ManTech Program promote the key attributes supporting these needs.[15] Doing so is in ManTech's best interests. A healthy, sufficient, and effective defense manufacturing infrastructure, manned by a flexible, innovative and capable defense manufacturing workforce, underpins the ManTech program's mission effectiveness and broader industrial preparedness in multiple ways. Support for this thrust area is addressed in two separate enabling goals: (1) addressing ManTech promotion of investment in new plants and equipment and their supporting systems for industrial innovation and readiness, and (2) ManTech support for a highly capable, well trained and educated defense manufacturing workforce, and active support for a strong national manufacturing workforce.

15 Specifically, DoDD 4200.15 requires investments in ManTech to "promote capital investment and industrial innovation in new plants and equipment by reducing the cost and risk of advancing and applying new and improved manufacturing technology" and "sustain and enhance the skills and capabilities of the manufacturing work force, and promote high levels of worker education and training."

Low risk and cost follow from implementation of manufacturing readiness as a management criterion.

Enabling Goal 4.1: *Active promotion of investment and innovation in manufacturing infrastructure and management systems.* The objective of this goal is to actively promote sufficient government and industry investment in new plants and equipment and in manufacturing management innovations, all in support of industrial preparedness. Sustained achievement of this goal reduces the cost and risk of advancing and applying new and improved manufacturing technology. A critical enabler for this goal is the successful transition of ManTech project results across multiple platforms, which in turn serves as a catalyst for capital investment. The cost and risk of manufacturing technology transition is reduced through implementation of manufacturing readiness as a management criterion, along with the use of technology transition plans. A technology transition plan documents the customer needs and technical metrics and establishes a threshold value for all Key Parameters. ManTech should investigate appropriate uses of incentive mechanisms, department policies, and statutory changes, in concert with ODUSD(IP).

Enabling Goal 4.2: *Effective ManTech contribution to a highly capable, well educated defense manufacturing workforce.* The advanced manufacturing enterprise depends on a highly interactive mix of systems, processes, and manufacturing technologies, requiring a highly skilled and competently interfacing workforce. This workforce must embrace continuous lifelong learning and pursue increasingly difficult levels of standardized, validated, and

certified portable skills to be effective. For the connected and collaborative manufacturing environment to be effective, a new set of workforce skills will need to be developed and deployed going forward. Net centric, model based enterprise, and manufacturing readiness principles cannot effectively function without broad minded, technically competent employees, from the shop floor throughout the manufacturing and engineering organizations.

The Department of Labor has created the *Framework of Competencies by the Advanced Manufacturing Industry,*[16] which defines eight tiers of competencies, ranging from personal and academic foundation knowledge through industry sector and occupation specific technical requirements. ManTech will contribute to several tiers within this framework and will provide effective leadership within specific competencies.

This goal has several aspects, which can be aligned primarily with specific sectors of the defense manufacturing workforce.

Enabling a highly trained workforce requires coordination and support for multiple tiers of competencies, within both the organic and non-organic workforce.

- *Organic defense manufacturing workforce:* Coordination with DoD human capital management organizations, with declared objective to revitalize organic manufacturing expertise. Partner with DAU to provide updated PQM (Production / Quality / Manufacturing) workforce qualifications and continuous training topics. Active support for Service/Agency workforce management initiatives.
- *Knowledge Management (KM) systems:* Support for effective use of KM systems for capture and dissemination of manufacturing skills expertise in defense-essential domains. Support Manufacturing Skill Standards Council (MSSC) qualification to ensure a sufficiently skilled supply chain.
- *Non-organic/national defense manufacturing workforce:* Definition of industry-sector competencies enabling the advanced manufacturing enterprise throughout the manufacturing workforce. Seek active and enduring DoD support for federal, state, industry and academic initiatives to create and sustain a world-class and sufficiently sized national defense manufacturing workforce. Participation in STEM (Science, Technology, Engineering, and Mathematics) related initiatives to attract and retain

16 The report, *Framework of Competencies by the Advanced Manufacturing Industry*, was first published in 2006 by the Department of Labor, Employment and Training Administration. The report is available at http://www.doleta.gov/pdf/AdvncdManufactFWK.pdf

manufacturing-related expertise. Specific collaboration with the federal and state governments, industry, and academia is necessary.

MANTECH'S STRATEGIC RELATIONSHIP TO DEFENSE AFFORDABILITY

Figure 10 graphically displays how the ManTech Program's four strategic thrusts address the defense manufacturing challenges presented earlier in the high-level decomposition of the Defense Affordability problem (Figure 2). Pursuit of these thrusts, in turn, helps to establish multiple inroads for improving

All four ManTech strategic thrusts make key contributions to improving affordability of defense system acquisition and life-cycle costs.

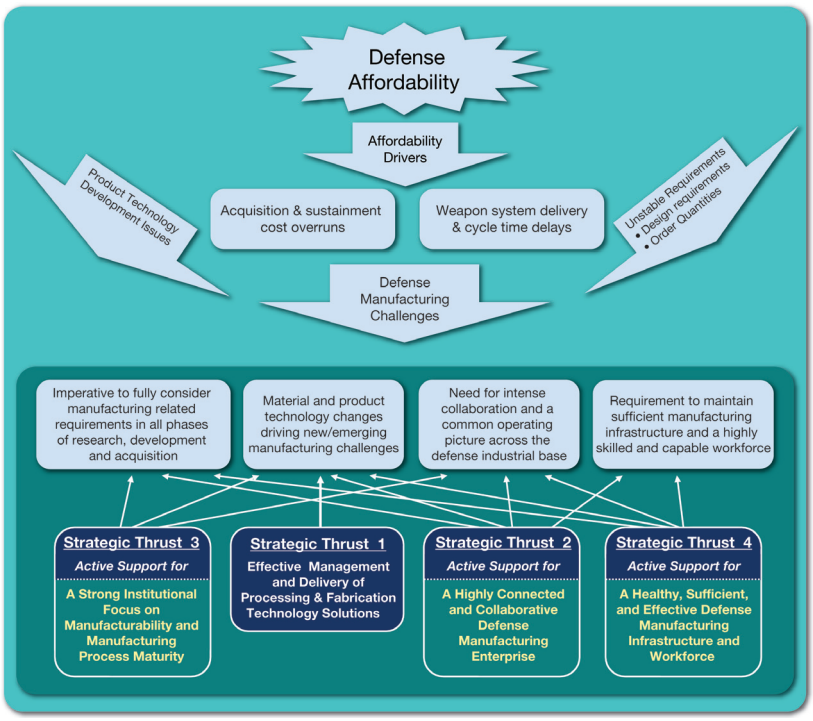


Figure 10. The Relationship Between ManTech's Thrusts and Defense Affordability

affordability. While ManTech is only one of many tools that DoD needs to improve affordability, ManTech's strategic thrusts play a key role in this process. With the program's thrusts and goals now defined, Section V addresses key mechanisms for assessing the effectiveness of the DoD ManTech Program.

V. MECHANISMS FOR ASSESSING PROGRAM EFFECTIVENESS

Mechanisms at three governance levels:
- ***Component/ execution level***
- ***JDMTP portfolio coordination level***
- ***OSD oversight***

Assessment of ManTech program effectiveness is essential and should be focused on progress made towards meeting the program's enabling goals, presented in the previous section. Program effectiveness is assessed through mechanisms at three levels in the governance structure of the ManTech Program:

- At the component/execution level; namely, each Military Department and participating Defense Agency
- At the portfolio coordination level, by the JDMTP and its subpanels
- At the policy and oversight level, by the Office of the DUSD (AS&C) within DDR&E

Each organizational layer in the governance structure includes assessment activities closely aligned with the annual planning, management and execution cycles of the ManTech program. In the paragraphs below, recommended assessment and reporting mechanisms will be presented in a manner that leverages existing activities within each layer of the governance structure.

MECHANISMS AT THE PROJECT EXECUTION LEVEL VIA DOD COMPONENTS

At the DoD component execution level, the ManTech programs are part of the S&T program planning, management, and assessment process. Each Military Department and participating DoD Agency develops investment plans based on the needs of current and future acquisition and sustainment programs. Resources are allocated and reviewed in the PPBES process and are reflected in the R-1 through R-4 exhibits submitted to Congress as part of the annual budget justification materials that support the President's Budget. Annual reviews of these ManTech programs are conducted by the Military Department or DoD Agency S&T organization responsible for ManTech to ensure that:

- Each project is planned with specific cost, schedule, performance and technology transition objectives.
- Each project has milestones for in-progress reviews by the government program manager to assess progress toward the project objectives.
- Each project manager constructs and maintains a transition plan, which contains specific details on manufacturing needs, interim and final customer(s), transition schedule, and transition metrics.
- Each project has effective coordination between the ManTech project team and the primary transition target (Acquisition PM/PEO, depot, logistics center, shipyard, company, or industry sector).

Assessment tools managed by the program component activities are complete and robust.

While each Military Department or DoD Agency may choose a separate format, schedule and assessment team structure, the assessment should provide an effective evaluation of progress towards meeting the core objective of ensuring technology transition. Descriptions of each Military Department and DoD Agency's current review process are contained in Annex C. For each component, the execution of each program is assessed at least once annually against project metrics, technical milestones and transition plans. Other reviews occur on a monthly or quarterly basis to monitor program management criteria.

MECHANISMS AT THE JDMTP PORTFOLIO COORDINATION LEVEL

Portfolio coordination activities occur within the JDMTP, primarily within the joint-service, technical subpanel level. Each of the JDMTP's technical subpanels performs an annual portfolio review under a set of coordinated rules set forth by the JDMTP. The portfolio review process is described in detail in Annex C. The review provides a peer-review assessment of each current ManTech project within each portfolio, using the following five criteria:

Key to the review process is the JDMTP scoring criteria measuring: needs and benefits, metrics, progress, transition, and leveraging.

- Overall needs and benefits
- Technical metrics
- Program progress
- Technology transition
- Program leveraging

The portfolio reviews include a strong focus on leverage and transition objectives which provide the widest possible applications across component programs. Portfolio reviews feature participation by technical experts from each DoD component as well as from industry, R&D labs, and some acquisition programs.

Additionally, the status of each overall portfolio is described through top level measures such as average portfolio rating in comparison to previous years, distribution of projects among technical taxonomy areas, average project size, funding leverage from outside ManTech, and project distribution among DoD components. These measures provide the JDMTP principals with a top-level assessment of both the current health and make up of each portfolio as well as the trends within the technology taxonomy distribution.

In addition to the portfolio review, the JDMTP has an annual cycle of coordination events, such as the semi-annual spring and fall "All-Hands" meetings. These events feature status reports from Service and Agency principals, technical subpanels and ad-hoc working groups. The joint-service working groups were formed to focus narrowly on specific objectives, such as manufacturing readiness, warfighter relevance, power and energy, RF modules, and lead-free electronics.

The JDMTP also provides logistics support for the annual Defense Manufacturing Conference, with one Military Department (on a rotating basis) acting as "lead" for

conference support in terms of recruiting DoD speakers, setting agenda topics, and communications. The conference is the only DoD-sponsored manufacturing conference and draws roughly 1,000 government and industry attendees every December. The conference represents an effective mechanism for dissemination of program results and assessment of transition and implementation across the industrial base.

MECHANISMS AT THE OSD/OVERSIGHT LEVEL

The OSD Manufacturing Technology Office is located within the ODUSD(AS&C) and has primary responsibility to assess strategic, enterprise-level program performance and inform senior department-level decision makers, including outreach to partner communities and engagement with industry. The OSD ManTech Director reports periodically to the DUSD(AS&C) on the health of the program, including the status of any policy directive initiatives and training programs (for example, manufacturing readiness assessments)

OSD has primary responsibility to assess strategic, enterprise-level program performance and inform senior Department-level decision makers.

OSD manages oversight of the ManTech program through the executing components, and also by conducting outreach activities and maintaining liaison with communities connected to ManTech. These communities include the warfighter or combatant commands, acquisition program offices, science and technology laboratories, academia, industry associations and consortia, and other DoD organizations such as the Office of the Deputy Under Secretary of Defense for Industrial Policy. These outreach activities function to provide dual benefits for the program, that is, robust engagement with the customer base to capture needs and assess program effectiveness as well as broad communication of program benefits and accomplishments. In particular, engagement with industry brings feedback on ManTech Program management and execution activities, which proves critical to ensuring effective transition, as industry often represents the final decision gate for implementation.

To fully leverage ManTech's position within the Defense Science and Technology (S&T) enterprise, a ManTech Program status briefing will be presented periodically to the joint-service Defense Science and Technology Advisory Group (DSTAG), as requested by the Director, Defense Research and Engineering. This process will enhance alignment within the S&T community and assist the Department

in both providing centralized guidance and ensuring proper execution. This periodic briefing will also serve to further disseminate and communicate the program's record of accomplishments to senior S&T leadership.

The OSD ManTech Director has responsibility for preparing and submitting reports as required by Congress or statute. Recent examples include reports on High Performance Manufacturing Technology and Implementation of ManTech Projects receiving FY03-FY05 funds, as well as providing biennial updates to this strategic plan. These reports broadly represent the state or health of the Department's Manufacturing Technology Program, including such topics as implementation effectiveness, industrial base benefits, and Department guidance into future investment areas.

SUMMARY OF PROGRAM GOVERNANCE

Leveraging existing practices, when and where possible to serve as assessment tools, is ideal.

Table 2 provides a summary analysis of organizational roles and responsibilities for each of the enabling goals. As part of their execution, coordination, or oversight roles, each organization will employ appropriate assessment mechanisms to measure progress towards achieving the goals of this strategic plan. As important as it is to ensure assessment mechanisms are in place, it is equally important to limit additional burdens placed on agencies striving to achieve change. Therefore, leveraging existing practices, when and where possible, to serve as these assessment tools is ideal.

Table 2. Program Assessment Responsibilities, by Goal and Governance Level

Enabling Goals			Responsibility for Goals		
			Component Management*	JDMTP	OSD ManTech Office
Thrust 1	1.1	A coordinated investment process to effectively manage manufacturing technology development and transition across organizational and programmatic seams			
	1.2	Timely and effective delivery of defense-essential processing and fabrication technology solutions, coordinated within joint service portfolios			
Thrust 2	2.1	Innovative, enterprise-level ManTech initiatives enabling collaborative and network centric manufacturing			
	2.2	Robust dissemination of ManTech Program results throughout the Defense Industrial Base.			
Thrust 3	3.1	Effective policies and practices to assess and improve manufacturing readiness			
	3.2	Full integration of "Design for Manufacturability" across the defense acquisition cycle			
	3.3	Structured analysis of manufacturing cost drivers for ManTech emphasis, in partnership with PEOs and Industry			
Thrust 4	4.1	Active promotion of investment and innovation in manufacturing infrastructure and management systems.			
	4.2	Effective ManTech contribution to a highly capable, well educated defense manufacturing workforce			

* Refer to Annex C for detailed descriptions of component management structures.

Primary Planning & Execution
Secondary Planning & Execution
Policy & Oversight
Coordination & Review

As presented in this section and summarized in the previous table, effective organizational governance and assessment mechanisms are in place to assess ManTech Program progress in meeting all of the enabling goals supporting the program's four strategic thrusts. DoD ManTech Program leadership at all levels must remain adaptable and maintain a focus of continuous process improvement in support of the ManTech Program's mission.

VI. CONCLUSION

The DoD Manufacturing Technology Program has consistently demonstrated strong value over an extensive history of support to defense manufacturing. The continued widening of DoD's mission sets and acceleration of defense system technology advancements will only increase the program's importance as a key manufacturing enabler. This is true not just in terms of its support for basic product realization and performance, but also in terms of the program's potential to help the Department tackle its acute defense system affordability challenges through proven cost savings and cost avoidance.

The dynamics of the 21st century are blurring the boundary between what used to be a largely self-contained defense industrial base and the broader marketplace, both nationally and globally. This increasingly intermixed manufacturing operating environment creates both challenge and opportunity for the program and the Department. The fundamental challenge during strategic planning was to identify those traditional ManTech practices warranting tuning and strengthening, while also understanding where these external dynamics are demanding broader adjustments to ensure full program resilience. The consensus conclusion was that the DoD ManTech Program has tremendous core strengths that will continue to benefit defense manufacturing in the future,

but they must be coupled with a highly flexible and adaptive posture to fully capitalize on 21st century changes.

This strategic plan reflects that balanced approach by leveraging ManTech's relatively modest investment base through a corporately developed set of strategies and enabling goals. The plan's ultimate objective is to enable this important, DoD program to continue to create sustained, positive impacts for the warfighter in the tradition of its past while elevating ManTech's value and performance to even higher levels through a broadened focus. The latter is achievable through the plan's structured, enterprise-level search for "game-changing" improvements.

With the right leadership focus and teamwork across the DoD and industry, the result will be an even greater realization of the vision of "a responsive, world-class manufacturing capability to affordably and rapidly meet warfighter needs throughout the defense system life cycle."

ANNEX A: STATUTORY REQUIREMENTS

This annex provides excerpted statutory language from the following two federal documents:

- **Excerpt 1.** Section 238 (Sec. 238) of Fiscal Year 2008 National Defense Authorization Act (FY 2008 NDAA)–Public Law 110-181–directing SecDef to develop a five-year strategic plan for the DoD Manufacturing Technology Program (Conference Report, December 6, 2007).
- **Excerpt 2**. Section 2521 of Title 10, United States Code, (10 USC § 2521), as amended by in Public Law 110-181 (FY 2008 NDAA), describing the basic requirements for the Department of Defense Manufacturing Technology Program.

Excerpt 1. Sec. 238, FY 2008 NDAA (Public Law 110-181)

SEC. 238. STRATEGIC PLAN FOR THE MANUFACTURING TECHNOLOGY PROGRAM.

(a) IN GENERAL.–Section 2521 of title 10, United States Code, is amended by adding at the end the following new subsection:
"(e) FIVE-YEAR STRATEGIC PLAN.–(1) The Secretary shall develop a plan for the program that includes the following:
"(A) The overall manufacturing technology goals, milestones, priorities, and investment strategy for the program.
"(B) The objectives of, and funding for, the program for each military department and each Defense Agency that shall participate in the program during the period of the plan.
"(2) The Secretary shall include in the plan mechanisms for assessing the effectiveness of the program under the plan.
"(3) The Secretary shall update the plan on a biennial basis.
"(4) Each plan, and each update to the plan, shall cover a period of five fiscal years.".
(b) INITIAL DEVELOPMENT AND SUBMISSION OF PLAN.–
(1) DEVELOPMENT.–The Secretary of Defense shall develop the strategic plan required by subsection (e) of section 2521 of title 10, United States Code (as added by subsection (a) of this section), so that the plan goes into effect at the beginning of fiscal year 2009.
(2) SUBMISSION.–Not later than the date on which the budget of the President for fiscal year 2010 is submitted to Congress under section 1105 of title 31, United States Code, the Secretary shall submit to the Committee on Armed Services of the Senate and the Committee on Armed Services of the House of Representatives the plan specified in paragraph (1).

Strategic plan for the Manufacturing Technology Program (sec. 238)

The Senate amendment contained a provision (sec. 253) that would require the development of a strategic plan for the Manufacturing Technology Program.

The House bill contained no similar provision.

The House recedes with an amendment that would clarify the time period covered by the plan and modify the requirements for development of the plan and for its submission to Congress.

The conferees are supportive of the efforts of the Manufacturing Technology Program to enhance the producibility, improve the performance, and increase the affordability of defense systems.

The conferees note that the Defense Science Board, in its recent study entitled, ''The Manufacturing Technology Program: A Key to Affordably Equipping the Future Force'' recommended that the Department of Defense ''ensure implementation'' of the Manufacturing Technology Program strategic plan and investment strategy ''with periodic reviews of plan execution.'' The conferees believe that this provision, as well as other manufacturing-related provisions adopted by the conferees, are consistent with that recommendation and would support efforts to identify best practices that can be used in making future manufacturing technology investments and transitioning technologies to the defense industrial base.

Excerpt 2. 10 USC § 2521, Manufacturing Technology Program

UNITED STATES CODE

TITLE 10–ARMED FORCES

Subtitle A–General Military Law

PART IV–SERVICE, SUPPLY, AND PROCUREMENT

CHAPTER 148–NATIONAL DEFENSE TECHNOLOGY AND INDUSTSRIAL BASE, DEFENSE REINVESTMENT, AND DEFENSE CONVERSION

SUBCHAPTER IV–MANUFACTURING TECHNOLOGY

§ 2521. Manufacturing Technology Program

(a) ESTABLISHMENT.–The Secretary of Defense shall establish a Manufacturing Technology Program to further the national security objectives of section 2501(a) of this title through the development and application of advanced manufacturing technologies and processes that will reduce the acquisition and supportability costs of defense weapon systems and reduce manufacturing and repair cycle times across the life cycles of such systems. The Secretary shall use the joint planning process of the directors of the Department of Defense laboratories in establishing the program. The Under Secretary of Defense for Acquisition and Technology shall administer the program.

(b) PURPOSE OF PROGRAM.–The Secretary of Defense shall use the program–

(1) to provide centralized guidance and direction (including goals, milestones, and priorities) to the military departments and the Defense Agencies on all matters relating to manufacturing technology;

(2) to direct the development and implementation of Department of Defense plans, programs, projects, activities, and policies that promote the development and application of advanced technologies to manufacturing processes, tools, and equipment;

(3) to improve the manufacturing quality, productivity, technology, and practices of businesses and workers providing goods and services to the Department of Defense;

(4) to focus Department of Defense support for the development and application of advanced manufacturing technologies and processes for use to meet manufacturing requirements that are essential to the national defense, as well as for repair and remanufacturing in support of the operations of systems commands, depots, air logistics centers, and shipyards;

(5) to disseminate information concerning improved manufacturing improvement concepts, including information on such matters as best manufacturing practices, product data exchange specifications, computer-aided acquisition and logistics support, and rapid acquisition of manufactured parts;

(6) to sustain and enhance the skills and capabilities of the manufacturing work force;

(7) to promote high-performance work systems (with development and dissemination of production technologies that build upon the skills and capabilities of the work force), high levels of worker education and training; and

(8) to ensure appropriate coordination between the manufacturing technology programs and industrial preparedness programs of the Department of Defense and similar programs undertaken by other departments and agencies of the Federal Government or by the private sector.

(c) EXECUTION.–

(1) The Secretary may carry out projects under the program through the Secretaries of the military departments and the heads of the Defense Agencies.

(2) In the establishment and review of requirements for an advanced manufacturing technology or process, the Secretary shall ensure the participation of those prospective technology users that are expected to be the users of that technology or process.

(3) The Secretary shall ensure that each project under the program for the

development of an advanced manufacturing technology or process includes an implementation plan for the transition of that technology or process to the prospective technology users that will be the users of that technology or process.

(4) In the periodic review of a project under the program, the Secretary shall ensure participation by those prospective technology users that are the expected users for the technology or process being developed under the project.

(5) In order to promote increased dissemination and end use of manufacturing technology throughout the national defense technology and industrial base, the Secretary shall seek, to the maximum extent practicable, the participation of manufacturers of manufacturing equipment in the projects under the program.

(6) In this subsection, the term `prospective technology users' means the following officials and elements of the Department of Defense:

(A) Program and project managers for defense weapon systems.

(B) Systems commands.

(C) Depots.

(D) Air logistics centers.

(E) Shipyards.

(d) COMPETITION AND COST SHARING.–

(1) In accordance with the policy stated in section 2374 of this title, competitive procedures shall be used for awarding all grants and entering into all contracts, cooperative agreements, and other transactions under the program.

(2) Under the competitive procedures used, the factors to be considered in the evaluation of each proposed grant, contract, cooperative agreement, or other transaction for a project under the program shall include the extent to which that proposed transaction provides for the proposed recipient to share in the cost of the project. For a project for which the Government receives an offer from only one offeror, the contracting officer shall negotiate the ratio of contract recipient cost to Government cost that represents the best value to the Government.

(e) FIVE-YEAR STRATEGIC PLAN.–

(1) The Secretary shall develop a plan for the program that includes the following:

(A) The overall manufacturing technology goals, milestones, priorities, and investment strategy for the program.

(B) The objectives of, and funding for, the program for each military department and each Defense Agency that shall participate in the program during the period of the plan.

(2) The Secretary shall include in the plan mechanisms for assessing the effectiveness of the program under the plan.

(3) The Secretary shall update the plan on a biennial basis.

(4) Each plan, and each update to the plan, shall cover a period of five fiscal years.".

(Added as § 2525, P.L. 103–160, § 801(a)(1), Nov. 30, 1993, 107 Stat. 1700;
revised in its entirety P.L. 103–337, § 256(a)(1), Oct. 5, 1994, 108 Stat. 2704;
P.L. 104–106, §§ 276(a), 1081(e), 1503(a)(28), Feb. 10, 1996, 110 Stat. 241, 454, 512;
P.L. 105–85, § 211(a),(b), Nov. 18, 1997, 111 Stat. 1657;
P.L. 105–261, §§ 213, 1069(a)(4),(5), Oct. 17, 1998, 112 Stat. 1947, 2136;
P.L. 106–65, § 216, Oct. 5, 1999, 113 Stat. 543;
redesignated § 2521, P.L. 106–398, § 1[344(c)(1)(A)], Oct. 30, 2000, 114 Stat. 1654, 1654A–71;
P.L. 107-314, § 213, Dec 5, 2002, 116 Stat. xxx.)
P.L. 108-136, § 1031, Nov 24, 2003, xxx Stat. xxx.)

ANNEX B: STRATEGIC PLANNING CONSTRUCT

This strategic plan establishes appropriate Department-level direction to align, unify, and guide the ManTech enterprise to maximize its value to the warfighter, DoD, and the nation. It meets the statutory direction in the Fiscal Year 2008 National Defense Authorization Act (NDAA) requiring the SecDef to develop a five-year strategic plan for the program (see Annex A).

The planning methodology underpinning the strategic guidance in this document took a broad view of defense manufacturing as an enterprise level system. The methodology focused on:

- Fully exploring and defining the enterprise, its purpose, its boundaries, and its extended interfaces, including understanding:
  - The basis for the ManTech Program through a detailed review of statutory and Departmental intent and program history
  - Required program capabilities
- Understanding the strategic context within which the enterprise operates, including how it may be changing
- Carefully identifying the population of key program stakeholders (both active and passive)
- Engaging with a sufficiently representative population of stakeholders to:
  - Establish a rich source of perspectives, or "demand signals."
  - Help identify ManTech and manufacturing enterprise capability gaps.

The planning effort also involved literature reviews of the following families of documents to help baseline the program and develop its strategic context (see Annex D for a full listing of references):

- Key ManTech Program directives and governance documents: that is, 10 U.S.C. 2521, Executive Orders, DoD directives, etc.
- Published plans and strategy documents influencing the DoD and component ManTech programs: for example, national-level strategy documents, USD(AT&L) and DDR&E strategic plans, Military Department and Defense Agency S&T plans, previous ManTech strategy documents, etc.
- Recent key reports and studies, both governmental and non-governmental; for example, DSB and GAO reports, required ManTech and other OSD reports to Congress, directed panel reports, assessments and studies, etc.
- Other influential or relevant documents, including key historical reports and initiatives

The JDMTP helped to identify key stakeholders and to arrange, over several months, engagements with senior-level government and industry stakeholders. This included conducting a ManTech strategic planning "Industry Day," during which

nearly 50 industry experts from the aerospace, electronics, ground/soldier systems, and shipbuilding sectors gathered to define strategic issues and to identify, categorize, and prioritize critical ManTech and manufacturing capabilities. The results are summarized in a 55-page report (see Annex D).

Throughout this engagement period, nearly 20 formal interviews were conducted with senior-level government stakeholders from the Congress (professional staff), OSD, the Military Departments, DLA, and DARPA, including defense PEOs, senior S&T leaders, and other senior decision makers (see Annex D). Questions were structured around a consistent set of interview questions focused on:

- Strategic context
- Industrial capabilities
- The role of ManTech
- Manufacturing process maturity

Finally, this data gathering period was also interspersed with frequent planning team briefings and perspective-gathering sessions with industry associations, their members, and activities, including:

- National Center for Advanced Technologies (NCAT)
- National Defense Industrial Association (NDIA) Manufacturing Division
- Aerospace Industries Association (AIA) Technical Operations Council (TOC)
- National Council for Advanced Manufacturing (NACFAM)

This systems approach provided perspectives through which the mission, environment, and circumstances of the DoD ManTech Program could be completely understood before strategic guidance was ever developed. This was key, because it led to a consensus view that the program's unique governance model, which centrally relies on the JDMTP framework (detailed in Annex C), is an appropriate design for the ManTech mission. It is an evolved design for governing an essentially "federated" enterprise of component-level manufacturing technology investment programs reporting through component S&T channels, with very broad OSD oversight and integration. Therefore, it was agreed that the guidance in this DoD-level strategic plan should enhance that basic framework by striking an important balance between:

- Providing sufficient, component autonomy to support component-level warfighter support priorities.
- Meeting collective, defense-wide ManTech priorities and needs.

Continually assessing and maintaining a proper balance between the two is important in order to maximize overall program effectiveness and value to the Department.

For similar reasons, the guidance and direction in this DoD-level strategic plan focuses primarily on the broad strategic thrusts and enabling goals that a federation of component-managed programs should be expected (and required) to *collectively*

support. Formulation and evaluation of specific courses of action as well as risk tradeoff decisions in support of the program's nine enabling goals will necessarily take different forms *within* each of the managing components (with the caveat that OSD's MS&T defense-wide program and JDMTP activities serve important cross-component coordinating functions).

The major elements of this strategic plan are therefore intended to enable effective, enterprise-wide unity of effort and to enable follow-on component development of appropriately detailed action plans. Those major elements of this plan are:

- A focusing theme centered on enhancing defense system affordability
- A defense manufacturing vision
- The ManTech Program's formal mission statement
- Four ManTech Program tenets
- Four program strategic thrusts, consistent with the defense manufacturing vision and ManTech Program mission, and which fall into one of two discernible categories:
  - A strategy aligned with core DoD ManTech Program responsibilities that are *not* shared by other DoD organizations or programs (Strategic Thrust 1)
  - Three other strategic thrusts aligned with defense manufacturing and industrial base responsibilities that are shared more broadly across the Department (Thrust areas 2, 3, and 4)
- Nine ManTech Program-focused enabling goals and recommended initiatives supporting each goal
- A comprehensive summary of the appropriate mechanisms for ManTech Program assessment, including responsibilities for their application at the three major governance levels

Finally, current statute requires that this strategic plan be updated biennially, which provides an excellent basis for regular assessments of the plan's effectiveness and to adjust the guidance therein.

ANNEX C: DOD MANTECH PROGRAM FOUNDATION, ACTIVITIES AND TECHNOLOGY INVESTMENT TOPICS

PART I: DOD MANTECH PROGRAM DESCRIPTION

The Manufacturing Technology Program is founded in Section 2521 of 10 United States Code:

[T]o further…national security objectives…through the development and application of advanced manufacturing technologies and processes that will reduce the acquisition and supportability costs of defense weapon systems and reduce manufacturing and repair cycle times across the life cycles of such systems.

As noted in Section III of this strategic plan, DoDD 4200.15 policy further defines the ManTech mission, which is implemented through the application of this directive.

In addition to providing mission guidance, DODD 4200.15 assigns responsibility for administering the ManTech program to the Director, Defense Research and Engineering (DDR&E), under the authority, direction, and control of the USD(AT&L). It is this language that guides OSD administration of the ManTech program, directing that DDR&E will:

- Provide centralized guidance and direction for the ManTech Program within the DoD and ensure that it is executed in accordance with set directives.
- Develop and maintain a joint planning process, and use that process in preparing centralized program guidance.
- Ensure coordination between the ManTech Program and industrial preparedness and similar manufacturing programs of DoD, other Departments and Agencies, and the private sector.

Section III of this plan provides a more detailed description of the ManTech mission, to "anticipate and close gaps in manufacturing capabilities for affordable, timely, and low-risk development, production, and sustainment of defense systems." To ensure that investments of energy and resources are sufficiently spread across the spectrum of warfighter needs, a ManTech division is located within each of the Military Departments (Army, Navy, Air Force) as well as DLA and the MDA, with OSD oversight. Coordination among each of these ManTech programs is recognized by all as essential to achieving broader outcomes.

This critical need for multi-service leverage and technical portfolio management prompted the creation of a coordination body known as the Joint Defense Manufacturing Technology Panel, or JDMTP. The charter for this organization recognizes two tiers of required coordination: a "principal" panel, comprised of a senior technology manager from each program

component, overseeing a series of technical "subpanels," each associated with specific technology sectors (presently Metals, Composites, and Electronics). Both organizational tiers of the JDMTP have multi-component membership and work together to "identify and integrate requirements, conduct joint program planning, and develop joint strategies for the ManTech programs conducted by the Army, Navy, Air Force, and Defense Logistics Agency."[17] The JDMTP principals typically meet monthly to guide the panel's strategic mission and high-level investment topics, while the entire panel meets semi-annually to monitor the execution of ManTech initiatives and provide status updates for working group activities. The technical subpanels meet quarterly to develop multi-service investment topics, assess the technical portfolio, and plan technical conference activities. The subpanels are responsible for developing investment roadmaps for high priority defense requirements, by identifying projects with application across the joint services. To facilitate this process, and to provide support for peer review and technology transfer, the JDMTP has developed a structured annual review of the ManTech portfolio of projects, divided by technical topic area and conducted by the subpanels.

JDMTP Portfolio Review Process

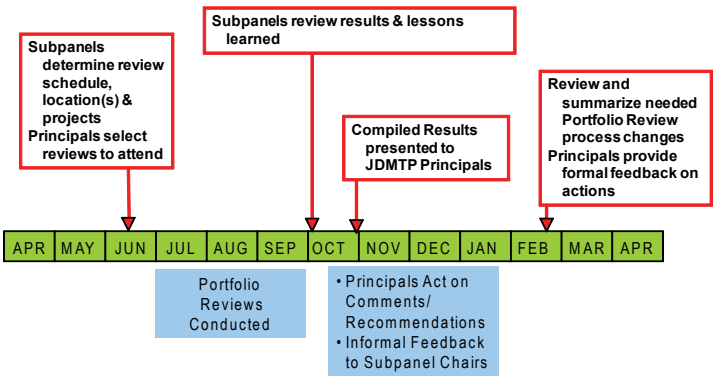
The history of ManTech's portfolio review process can be traced back to the 1990s, when ManTech fell under the purview of the Technology Area Review and Assessment (TARA) process. At that time, the ManTech Program was required to present an all-inclusive program review each January in support of the TARA process. In 2002, ManTech was relieved of its requirement to support the TARA process. Finding value in the review process, ManTech continued the annual portfolio review, with oversight by the JDMTP.

The portfolio review cycle begins each March with JDMTP subpanel members developing a list of projects to be reviewed. The goal is to review all ManTech projects assigned to a subpanel's portfolio. Later, independent industry subject matter experts are identified to participate in the review along with the subpanel members. Subpanel review plans are reviewed and approved by the JDMTP principals in April.

Between April and September of each year, subpanel organizations conduct a rigorous review of each of their identified projects. These reviews provide an analysis that covers the entire scope of the program.

Each October, subpanel organizations present a summary of the review results to the JDMTP. Principals are invited to all of these reviews and are encouraged to attend. The JDMTP, with

Portfolio Review Timeline



17 "Charter Joint Defense Manufacturing Technology Panel," June 8, 1999, p. 1.

support from identified industry experts, rates each of the projects. Each project is evaluated and rated on a scale of 1 to 5 in the following categories:

1. *Customer Needs and Benefits.* Target customers and important customer requirements have been identified and a clear and compelling story on benefits is stated. This includes a baseline, quantifiable benefits with targets, and a credible rationale for estimates. If possible, a clear case for pervasive benefits is established.
2. *Metrics*. Objectives have been established for the project which relate to key customer requirements. Goals and threshold values have been established for each of the key objectives and units of measurement have been defined that can be used to measure progress towards the goals.
3. *Progress.* The project is on schedule and progress to date is in line with the funding expended to date. The project is likely to meet or exceed all of its established goals within the currently available funding and on the projected schedule.
4. *Transition.* An implementing organization or customer is directly involved in planning for transition of the technology and is committed to implement the project results if threshold values for the objectives are met. All deliverables necessary for effective transition are on contract or otherwise addressed, with a clear and credible implementation strategy in place with funding identified for qualification or other implementation expenses.
5. *Leveraging or Sharing of Resources.* The project is taking appropriate advantage of the results of previous and current related work both within and outside of the defense industry, as well as utilizing opportunities for funding or other resource support from industry, other DoD organizations, universities, or other agencies and organizations.

Results of these assessments are used for a variety of purposes. Trends can be established in a portfolio that can drive future actions. If projects are rated unusually low in one or more of the rating criteria, the JDMTP Principals can use the results to identify necessary management actions on programs managed by their Service or Agency. Programs that are rated unusually high can be considered for awards or other recognition.

Industry Coordination

The DoD ManTech program, through the JDMTP, coordinates extensively with the defense manufacturing industry through its industry liaison partner, the National Center for Advanced Technologies (NCAT). The Center is a not-for-profit organization with the goal of facilitating communication between industry, academic and government communities in order to promote affordability and to reduce the cycle time for technology transition. ManTech leverages the substantial industry and academic partnerships of NCAT to address technological and management issues such as Technology Transition Initiatives, Manufacturing Readiness Levels and Assessments, Manufacturing Technology Roadmaps, Industrial Partnerships, Evolutionary Acquisition Strategies, and structured assessments of System Affordability.

DoD ManTech relies on NCAT to identify and draw on the resources of key stakeholder representatives from Industry, Academia and Government and then facilitate industry participation in the JDMTP through the Multi-Association Industry

Affordability Task Force. At the direction of the JDMTP, NCAT forms specific manufacturing study teams and nominates appropriate industry representation for ongoing JDMTP initiatives. DoD and industry work together to address common issues facing both industry and DoD communities.

The current membership of the Multi-Association Industry Affordability Task Force includes the members from the Industry Associations and Professional Societies listed below:

- Aerospace Industries Association of America (AIA)
- Government Electronic Industries Alliance (GEIA)
- National Defense Industrial Association (NDIA)
- Society of Manufacturing Engineers (SME)
- National Association of Manufacturers (NAM)
- The Armed Forces Communications and Electronics Assoc (AFCEA)
- The Association for Manufacturing Technology (AMT)
- American Electronics Association (AEA)
- National Center for Manufacturing Sciences (NCMS)

Current ManTech Technology Targets

Current technical topics of interest to the Manufacturing Technology Program follow. These technical descriptions include both current and future programmed investments as well as unfunded initiatives that are being pursued based upon future warfighter capability needs. In many cases, technical roadmaps will be constructed to establish formal capability, schedule or cost gaps against defense system requirements, which will help to prioritize investments within these topics.

The technology initiative topics are organized by existing subpanel domain (Electronics, Composites and Metals) and then by taxonomy areas within each domain. This listing does not feature any priority order.

Electronics Investment Area

- RF Devices:
  - RF devices/modules for AESA antennas, including phase shifters, SiC/GaN devices and MMICs.
  - RF components for affordable data-links.
  - WBG Material (Substrate) improved quality manufacturing for yield, reliability and affordability.
  - Thermal management materials, devices, and processes for RF modules.
  - Hybrid semiconductor/VED microwave power modules.
- Power and Energy:
  - High power, high energy density, Lithium-ion batteries to support platform (silent/quiet) mobility, and silent watch platform capabilities.

- SiC high power switching device fabrication and high temp packaging for shipboard power and more electric aircraft.
- Thermal management materials, devices, and processes for high-power modules.
- Fuel cells for portable, mobile, and vehicular applications.
- High energy throwaway batteries for C4ISR applications.
- Reserve batteries for weapons systems applications.

• IR/EO:

- Next-generation uncooled IR sensors for Soldier Systems.
- Third-generation IR cooler manufacturing technology.
- High-power SiC PiN Diode Manufacturing.
- High-resolution Micro-Display components.
- Multispectral Mid-IR lasers for DIRCM.
- Next-generation communications (such as software defined or optical-based).
- Yield improvement of Large Format Long Wave IR sensors.
- Alternative Detector Material for LWIR Tactical and Strategic Applications (such as SLS).

• MEMS:

- Low-cost, high-G force, high-accuracy MEMS-based inertial measurement units, and MEMS Safe-and-Arm for fuze technology.
- Low-cost, high-reliability RF MEMS devices.

• Nanotechnology:

- Carbon nanotube-enhanced ultra capacitors for high power and alternate power applications.
- Carbon nanotube-based 3-dimensional solar cells.

• Sensors:

- Flexible displays used by soldier systems for both dismounted and mobile applications.
- Sensors and networks for embedded composites.
- Low-cost, high-reliability 3-dimensional printing of electronics sensors for embedded systems monitoring.
- Low-temperature, low-power LCD displays.

• Packaging:

- Advanced microcircuits emulation for obsolescence mitigation.
- High-power high-density interconnect technologies.
- High-temperature passive components.
- High-temperature power electronics packaging (280˚C).
- Integrated MEMS packaging, including high-G capability.

- Lead-free: investigate new materials solutions, publish standards, repair/rework processes, control the supply chain.
- Solder-free components and assemblies.
- Low-cost, lightweight electronic enclosures with high thermal conductivity.

Composites Investment Area

- Transparency/LO:
  - Improved aircraft transparency to increase the life cycle of aircraft canopies while reducing production time and cost.
  - Airborne Low Observable coatings to reduce the time and cost for applications and maintenance of LO materials.
- Armor:
  - Transparent spinel armor to provide the capability to produce armor large enough and at a low enough cost for fielding, thus improving ballistic protection.
  - Improved protective headgear for affordable manufacture of new materials and designs.
- Structures:
  - Embedded sensors for composite structures to develop and demonstrate new manufacturing techniques for integrating sensor networks into composite aviation structural components.
  - Affordable frame technology for broad application in basic structural designs.
  - Helicopter structures and drive train composite structure for weight reduction.
  - Integration/embedment of apertures for EW, GMTI, overall (360-degree) situational awareness.
- Marine composites:
  - Large marine qualified structures for ship and submarine applications, specifically large and thick structures.
  - Composite-to-metal joining capability.
- High-temperature:
  - Ceramic matrix composites to improve propulsion system affordability and provide engine applications that realize lower weight to enable increased performance and room for engine growth.
  - High-temperature (more than 500°F) organic matrix composites for secondary structure.

Metals Investment Area

- Advanced Materials:
  - Metal alloy equivalency: substituting older qualified alloys which are out of production with newer metal alloys that have a robust supply chain. This will require completion of statistically adequate databases for the Metals Handbook.
  - Replacement materials for REACH requirements: reaction to global policies for hazardous materials, particularly in corrosion protection.

- Advanced/Intelligent machining:
  - Intelligent machining network modeling and standards
  - Advanced precision and thin walled machining.
  - Precision robotic drilling within 3-dimensional structures.
  - Smart machine platform initiative, “first part correct.”
- Joining:
  - Bonding of metal and ceramic armor materials for improved efficiency and bond strength.
  - Translational friction welding.
  - Shipyard welding precision: increase the precision and fit of welding processes for shipyard build processes.
  - Titanium welding/brazing with alternate filler materials.
  - Higher efficiency gas metal arc/hybrid processes for steel fabrication.
  - Planned distortion control for shipbuilding plates and structures.
  - Lightweight ground vehicle manufacturing.
  - Advanced casting processes for lightweight alloys, that is, ablative process, continuous fiber reinforcement, particulate reinforcement, etc.
  - Affordable lightweight structural and appliqué armor, and titanium for lightweight armament and ground vehicles to enable affordable manufacture for the FCS vehicles, which will also be broadly applicable to future up-armor requirements.
  - Next generation of metal matrix composites for armor and backing materials.
- Casting and forgings:
  - Castings affordability initiative to continue significantly reducing the inherent cycle time limitations for the castings industry.
  - Forging industry database: reducing cost through the forging supply chain database.
  - Performance-based NDE standards.
  - Casting design for manufacturing and performance.
  - Casting production and performance modeling.
  - Improved alloys for weight-sensitive performance.
  - Toolless manufacturing.
  - Post processing such as hipping for high-strength steel castings.

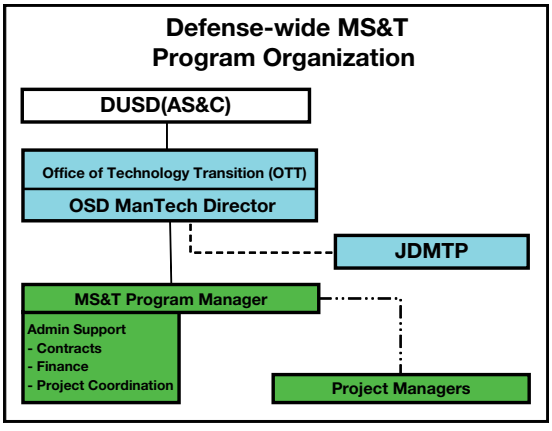
PART II: COMPONENT PROGRAM EXECUTION AND TECHNOLOGY FOCUS

Manufacturing Science & Technology (MS&T) Program (OSD ManTech Line)

Overview

The Defense-wide Manufacturing Science and Technology (MS&T) Program is a recent addition to the DoD ManTech Program. This program both responds to a recommendation from the 2006 DSB ManTech study (see Annex D) and supports the High Performance Manufacturing R&D pilot program established (but not funded) by Congress in the FY 2006 NDAA. The Defense-wide MS&T Program concurrently develops manufacturing processes with emerging technologies and transitions advanced manufacturing processes and technologies for achieving significant productivity and efficiency gains in the defense manufacturing base. The program addresses cross-cutting, game changing initiatives that are beyond the scope of any one Service or Agency. It complements the component ManTech programs by focusing on early, emerging technologies, cross-cutting DoD priorities, and enterprise-wide, above-the-factory-floor manufacturing issues. These MS&T initiatives are identified and ranked through road mapping and data call activities conducted in collaboration with DoD and industry manufacturing representatives and are intended to benefit multiple defense systems and platforms. The primary transition target may be a single Military Department or Defense Agency application, but there will be secondary transition targets in alternate components or applications, which may require additional assistance from those component ManTech or acquisition programs.

Organization



The governance of this defense-wide program consists of: (1) oversight and direction by the DUSD for Advanced Systems and Concepts (DUSD(AS&C)) within DDR&E, (2) investment guidance by the JDMTP, and (3) day-to-day execution by the MS&T Program Manager and individual project managers. The DUSD(AS&C) is responsible for program policies and final investment and resource management decisions. The OSD ManTech Director is responsible for project justification, for overseeing and directing program management activities, and for ensuring technical objectives are met. The MS&T Program Manager supports the OSD ManTech Director as the MS&T Program's executing agent. The OSD ManTech Director and MS&T Program Manager lead a team of project managers and jointly work with industry and the acquisition community to ensure technology transition plans are developed and that projects are effectively implemented. The JDMTP acts as a steering group for the defense-wide MS&T program and is responsible for identifying investment topics, guiding business cases and transition strategies, and selecting a lead manager for each project or technology initiative.

Initiatives

For the first years (FY08 and FY09) of the Manufacturing Science and Technology program, the following are examples of the technology initiatives within the MS&T portfolio:

- Ceramic matrix composite (CMC) manufacturing: demonstrate the advancement of manufacturing technologies for advanced turbine engines that result in significantly reduced weight, increased engine performance and fuel efficiency, and decreased maintenance.
- Low Observable Material manufacturing: advance manufacturing technologies to reduce cost and maintenance of low observable materials, specifically for: precision component fabrication, multi-spectral LO integration and minimum sustainment cost.
- System-on-chip manufacturing: advance manufacturing processes for packaging of system-on-chip systems for application in on-board SATCOM-capable platforms.
- Custom composite orthotics and prosthetics manufacturing: Integrate advanced manufacturing processes and materials to produce custom composite orthotics and prosthetics for armed service amputees
- Network Centric Manufacturing pilot project: integrate prototype and test beds with network-centric supply chain tools to demonstrate the positively affect on the product line.
- Model-Based Enterprise: extend the state of the art in modeling and simulation as it is applied during the systems acquisition process.
- Fixed and rotary wing aircraft structures: transform the way that airframes are constructed to significantly improve manufacturing cycle time and cost, and to make them less capital-intensive.
- Conformal load bearing antennas: enable the use of CLAS to increase antenna performance over conventional aircraft antennas by significantly reducing the manufacturing cost and lead times.
- Solder-free electronics: develop alternative materials and/or processes for fabrication and repair of electronic assemblies.
- Manufacturing readiness assessment capability: develop an organic MRA capability to meet the requirement for all major acquisition programs to perform an MRA prior to milestone reviews.

Successes

The OSD MS&T program, although young, has started to deliver results across the Department. One success story is the Network Centric Manufacturing project, which uses net-centric approaches to capture manufacturing process knowledge in order to create configurable supply chains, accelerate vendor start-up, and enable prototyping through organic government industrial bases.

This program recently applied these techniques to the M2 Machine Gun used by U.S. and NATO ground and sea forces. This 1930s-era legacy weapon system continues to experience critical spare parts shortages due to high demand, lack of

established vendor base, and inability to quickly "start-up" industrial base with a 2-dimensional hardcopy technical data package. The result was a distributed Electronic 3-dimensional Manufacturing Process Data File that enabled:

- Qualified vendor base increase from 1 to 4.
- Sourcing time savings of 36%.
- Engineering time savings of 58%.
- Manufacturing Readiness Level stability based on qualified process for future purchases.
- Access to vendor networks to make spares available in organic and commercial base for future needs.

Potential OSD MS&T Future Investment Topics

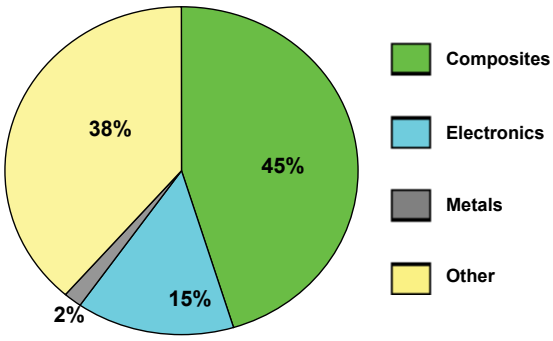
A primary goal of the MS&T program is to mature materials and process technologies alongside associated technology development activities, thus ensuring that technology maturity activities are paced by manufacturing maturity activities, reducing cycle time and creating more affordable defense systems. The following are examples of future investment topics with manufacturing requirements in which there are planned technology development efforts and for which there are multi-service implementation paths.

- Directed energy (offensive and defensive)
- Survivability
  - Ballistic protection
  - Low observable structures and transparencies
  - Countermeasures
- Disruptive green and energy technologies
  - Power and energy
  - Lead free solder
  - Nanotechnology for electronics
  - Fuel efficiency
  - Environmentally friendly manufacturing
- Manufacturing best practices
  - Model Based Enterprise
  - Supply chain framework

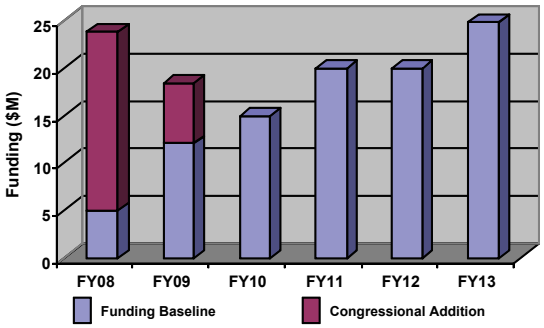
Investment Profile

MS&T invests in technology initiatives and single specific projects that focus on cross-cutting military manufacturing needs for critical metals, composites, electronics, and manufacturing process technologies. The program was initiated at $10 million in the president's FY2008 budget under the OSD RDT&E structure, increased to $12 million in the FY2009 Budget and averages $20 million over FY10-13 in the FY09 PB as shown in the above table. The FY08-FY09 MS&T portfolio is distributed across the technology areas as shown in the above left graphic, with the largest investment within the electronics area.

MS&T Program
Technical Area Investment Distribution
(FY08 – FY09 Average)



MS&T Funding Profile (FY09 PB)



MS&T Program Funding Profile (PE 0603680D8Z) -- $M						
	Appropriated		Requested (FY09 PB)			
	FY08	FY09	FY10	FY11	FY12	FY13
Baseline	5.0	12.0	14.9	19.9	19.9	24.8
Cong. Adds	18.8	6.4				
Total	23.8	18.4	14.9	19.9	19.9	24.8

Summary

The Defense-wide Manufacturing Science and Technology Program fits an essential need within the DoD manufacturing enterprise, attacking cross cutting, multi-service manufacturing gaps and developing material Processing and Fabrication solutions in parallel with associated technology development efforts. While only within its second year of existence, the program has been able to substantially affect affordability, cycle time, and performance within its portfolio. MS&T represents the sole OSD-directed manufacturing technology program, and it will continue to build an investment portfolio to deliver game-changing capabilities within the defense manufacturing enterprise.

Army ManTech Program

Overview

The Army Manufacturing Technology (ManTech) Program supports the development of essential manufacturing technologies that will enable producibility of new technologies with reliable processes and higher yield, and reduce the risk in transitioning military-unique manufacturing processes to production. This enables the Army Future Combat Systems (FCS) and other Future Force systems, as well as the affordable transition of new technologies that can enhance capabilities of Current Force systems. The primary focus of the Army ManTech Program is Army Technology Objectives-Manufacturing (ATO-Ms), which operate under guidance identical to Army Technology Objectives-Development (ATO-Ds).

Organization

The Assistant Secretary of the Army (Acquisition, Logistics and Technology) has overall responsibility for the Army ManTech program. Within this office, the Director for Technology provides oversight, guidance, and policy for the program. The U.S. Army Research, Development and Engineering Command (RDECOM), a subordinate command of the Army Materiel Command, has been further designated as the Army's ManTech program manager. RDECOM is therefore responsible for detailed program management; monitoring cost, schedule, performance, and results; and coordinating industry with the Army's Research, Development and Engineering Centers (RDECs) and the Army Research Lab (ARL). Individual projects are executed by the RDECs and ARL.

Service Focus

Army ManTech is integrated into the Army Science and Technology Working Group (ASTWG) process. Proposals are submitted through the laboratories and RDECs to RDECOM SOSI. The first level of review for ATO-Ms is the Warfighter Technical Council (WTC). The WTC is a one-star level body that reviews ManTech projects and the results are provided to the Army Science and Technology Working Group (ASTWG) for approval. Decisions by the ASTWG are validated by the four-star level Army S&T Advisory Group (ASTAG). Projects are approved through the ASTWG Process in one of three categories:

- ATO-Ms: this category consists of large-focus efforts, approved at the ASTWG and tracked by Secretary of the Army Acquisition Logistics and Technology (SAALT).
- ManTech combined ATO-Ds: this category assists technology transition, tackling critical technology affordability by addressing producibility and cost.
- Tracked efforts: this category consists of smaller stand-alone ManTech projects. Typically, the WTC approves tracked efforts.

Successes

Micro-Electro Mechanical Systems Inertial Measurement Unit (MEMS IMU). Army ManTech is assisting the Army meet its goal of becoming a lighter, faster, more lethal force. MEMS IMU assists in lowering the Army's logistical footprint and offers inherent cost savings (75% savings), size reduction (90% less volume and 66% less weight), reduced power consumption (80% reduction), and enhanced commonality. As a result of this program, the IMU cost was reduced from $15,600 per unit to $6,500 per unit. The IMUs have been implemented and are operational in Iraq and Afghanistan as part of the Excalibur 155mm precision artillery warhead. They are also on track to be integrated into Hellfire Missiles and the Mid-Range-Munition.

Durable Gun Barrel Materials–Composite Overwrap Process. Future Combat Systems (FCS) could not meet weight and lethality requirements without a lightweight gun system. An Army ATO-M developed and transitioned production-capable manufacturing processes for composite barrel overwrap used in high performance FCS cannons. The baseline FCS Mounted Combat System 120mm cannon design incorporated the technology, providing over 200 lbs in weight savings. This composite technology has also transitioned to the Electro-Magnetic (EM) gun programs for both the Army and Navy.

Program Initiatives

Though Army ManTech has a history of successfully funding manufacturing processes for producible, affordable, advanced enabling technologies, its continued pursuit of new and emerging technologies and manufacturing processes is what will lead Army ManTech and the soldier of the future into 2020 and beyond. Several projects are described below in additional detail.

Embedded sensor for composite structures. This ATO-M will develop and demonstrate new manufacturing techniques for integrating sensor networks into composite aviation structural components. This will result in the ability to gather airframe vibration/shock effects to potentially increase the time between overhaul (TBO) of airframe by 800 hours (8%), decrease weight (67 lbs), increase strength (29%), and reduce operations and maintenance costs (15%). The cost benefit to the Army is $95 million with a Return on Investment (ROI) of 17.1 to 1.

Transparent spinel armor. Transparent armor ceramics have not been available in the sizes needed and at a low enough cost to be implemented in armor systems. This tracked effort will provide the capability to produce transparent spinel for armor large enough and at a low enough cost so that advanced transparent armor systems can be fielded. The direct impact to the warfighter will be a better transparent armor that is lighter and thinner, with reduced visual distortions. Total potential *cost benefit to the Army is $68 million, with an ROI of 8.7 to 1.*

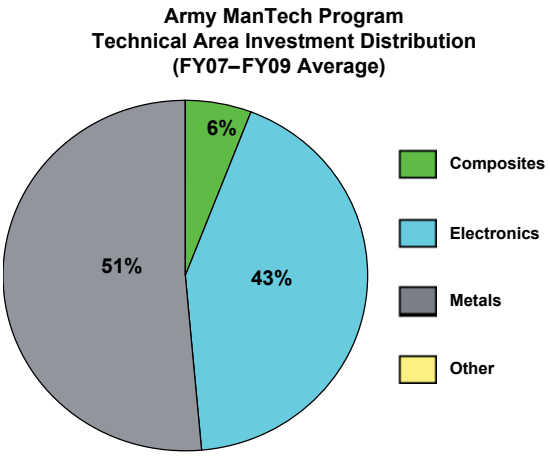
High power Lithium-ion batteries. Batteries with very high power density are needed to support FCS mobility. Currently, Lithium-ion batteries are expensive due to low production demand and semi-automated manufacturing processes. This initiative is improving the current manufacturing capability and will provide an affordable battery pack for FCS Ground Vehicle Programs. Total potential cost benefit is $121 million, with an ROI of 5.6 to 1.

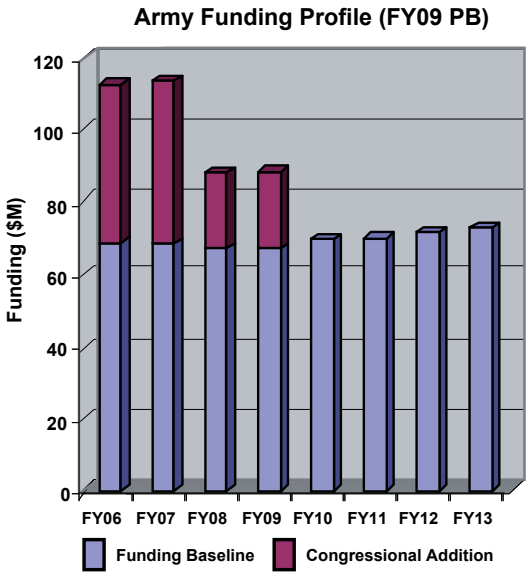
Program Reviews

The Army conducts semi-annual Internal Progress Reviews (IPRs) for cost, schedule, program metrics and implementation planning. Each program's Technology Transition Plan (TTP) is routinely evaluated to see if projected metrics and transition milestones have been met. These IPRs and other supporting program documentation feed directly into the Army ManTech budget item justifications and success stories.

Investment Profile

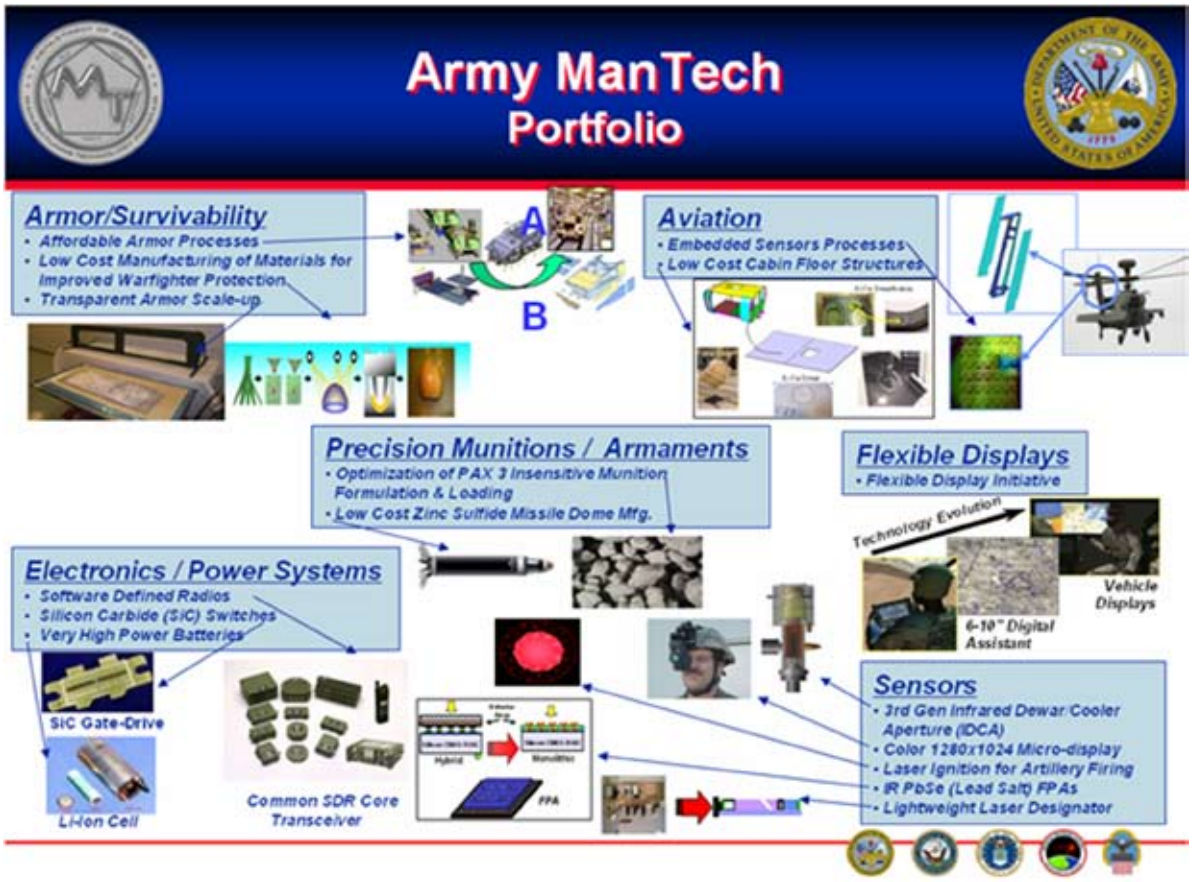
The Army ManTech Program is approximately $70 million per year over the FY06-FY13 timeframe, displaying a relatively stable level of investment. Congressionally directed funding represents a substantial addition to the Army's funding, averaging $30 million per year from FY06-FY09, as shown is the adjacent table. The Army investment portfolio is distributed across the technology areas as shown in the above graphic, with the majority of investment within the metals and electronics technical areas. This distribution reflects the army's priority investments, including armor/survivability, aviation, electronics and power systems, sensors, precision munitions and armaments and flexible display technology.





Army ManTech Program Funding Profile (PE 0708045A) -- $M								
	Appropriated				Requested (FY09 PB)			
	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13
Baseline	68.5	68.1	66.9	67.1	69.6	70.2	71.7	73.4
Cong. Adds	43.9	45.3	21.0	24.0				
Total	112.4	113.4	87.9	91.1	69.6	70.2	71.7	73.4

Investments result in cost avoidance and reduced risk of transitioning military-unique manufacturing processes into production. Projects selected through the ASTWG process ensure that the highest manufacturing priorities of the Army are addressed.



Summary

Army ManTech continues to meet Army requirements while employing sound processes that stress affordability and producibility. Army ManTech continues to be an enabling force that is harmoniously aligned with larger OSD ManTech strategic goals.

Navy ManTech Program

Overview

The Navy ManTech Program provides for the development of enabling manufacturing technology and the transition of this technology for the production and sustainment of Navy weapon systems. Customers range from the acquisition Program Managers (PMs) and industry responsible for transitioning major Navy weapon systems from development into production, to the logistics managers at the naval depots and shipyards responsible for repair, overhaul, and remanufacture of major weapon systems.

Organization

The Navy ManTech Program is managed by the Office of Transition within the Office of Naval Research (ONR), with direct oversight from the Chief of Naval Research. ONR's Office of Transition is composed of transition-centric programs including ManTech, Future Naval Capabilities (FNCs), the Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR), and other transition initiatives.

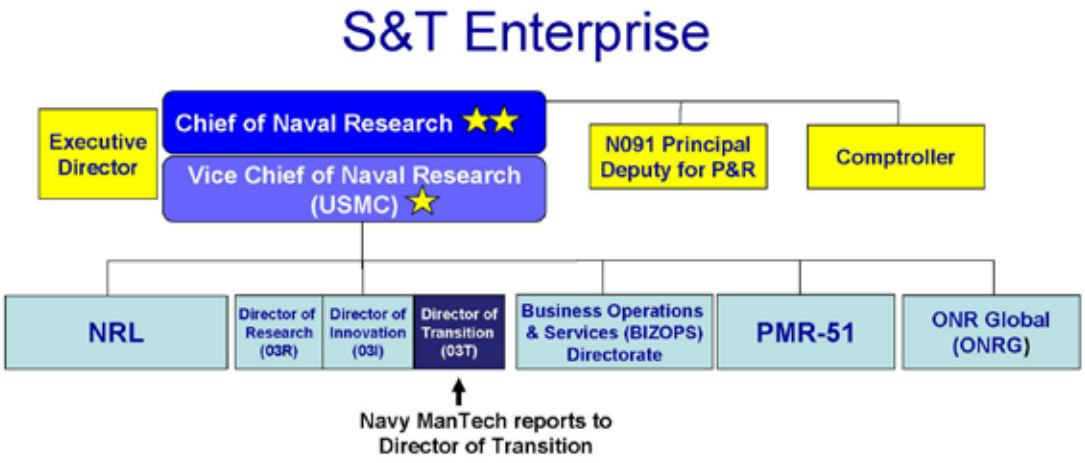


Figure 1. ONR Organization

The Navy ManTech Program executes through its Centers of Excellence (COEs) with expertise in specific technology areas. ManTech's nine COEs are: Benchmarking and Best Practices Center of Excellence (B2PCOE) (Philadelphia, PA); Center for Naval Shipbuilding Technology (CNST) (Charleston, SC); Composites Manufacturing Technology Center (CMTC) (Anderson, SC); the Electro-Optics Center (EOC) (Freeport, PA); Electronics Manufacturing Productivity Facility (EMPF) (Philadelphia, PA); Energetics Manufacturing Technology Center (EMTC) (Indian Head, MD); Institute for Manufacturing and Sustainment

Technologies (iMAST) (State College, PA); Navy Joining Center (NJC) (Columbus, OH); and Navy Metalworking Center (NMC) (Johnstown, PA).

Service Focus

Reducing the acquisition cost of current and future platforms is a critical goal of the Navy. As a result, in 2006, ManTech adopted a shipbuilding affordability investment strategy and is currently focused on affordability improvements for four major acquisition platforms: DDG 1000, CVN 21, the Littoral Combat Ship (LCS), and the VIRGINIA Class Submarine (VCS). It is ManTech's focus to help these four programs achieve their respective affordability goals by transitioning needed manufacturing technology which, when implemented, results in a cost reduction or cost avoidance (measured as a per-hull cost reduction).

Successes

Since switching to its shipbuilding affordability focus in 2006, Navy ManTech is impacting both ship and submarine affordability. ManTech has established good working relationships with relevant Program Offices and industry and has established a detailed internal planning effort. Affordability assessments on a per-platform basis, bought off by both the relevant Program Offices and industry, show good cost reduction potential, and ManTech's transition rate for projects is increasing. The first affordability projects are now transitioning and implementing on factory floors, and cost reduction values are being 'booked' by industry for these programs.

Recently, Navy ManTech projects have been recognized across the manufacturing industry for outstanding accomplishments. In 2007 alone, Navy ManTech was the recipient of three major awards in Defense Manufacturing: Improvement Initiative of the Year for 2007, a General Dynamics Electric Boat internal award; the 2007 Defense Manufacturing Achievement Award for Translational Friction Welding; and the 2007 Best Technical Session Paper Award at the Defense Manufacturing Conference (for HSLA-115 Steel for CVN 21 Weight Reduction).

Laser Image Projection. One of the two Navy ManTech projects sharing honors for Electric Boat's 2007 Improvement Initiative of the Year was the *Laser Image Projection* project. In this project, Navy ManTech demonstrated that laser image projection technology can successfully automate layout processes and significantly reduce the labor hours and span times for locating attachments and penetrations onboard VIRGINIA-class submarines. Electric Boat has piloted the new technology, and based on initial findings, a savings of 7,700 hours per hull is expected, which is an 85% labor hour reduction in comparison to the previous method.

HSLA-115. A second recent success is the *HSLA-115* project for the CVN 21 where reduction of topside weight and a lowering of center of gravity are very important. In this project, the performance and strength of HSLA-100 (high strength, low alloy) steel was improved through heat treatment. The new steel can be used at reduced thickness and, thus, reduced weight while meeting all performance requirements. It is expected that the weight savings for HSLA-115 on CVN 78 will

be between 100 and 200 long tons. The Future Aircraft Carriers Program Office has approved the use of HSLA-115 in the CVN 78 baseline design. HSLA-115 has been incorporated into the ship specifications and fabrication document allowing its use.

Program Initiatives

Although different in focus, scope, and size, the four shipbuilding initiatives for DDG 1000, CVN 21, LCS, and VCS function similarly. For each, ManTech has established an IPT with representatives from Navy ManTech, the platform Program Office, and representative industry. The IPT meets regularly to coordinate and review the portfolio and ensure that projects are completed in time to meet the platform's window of opportunity for implementation.

Taking the VCS initiative as an example, extensive interaction and cooperation between Navy ManTech, the COEs, General Dynamics Electric Boat, Northrop Grumman Shipbuilding, PEO (Subs), and the PMS 450 Program Office has resulted in a focused ManTech initiative that is now successfully transitioning and implementing technology. The current VCS ManTech portfolio contains approximately 60 projects and has a potential cost savings of approximately $30 million per hull. To date, seven of the ManTech affordability projects have completed and are in some phase of implementation. Realized cost savings of $6.5 million per hull have been recognized by the Program Office and General Dynamics Electric Boat. These real acquisition cost savings are being negotiated into the Block III VIRGINIA Class submarine procurement, and a process has been established to achieve further savings during future submarine acquisitions.

Program Reviews

The Navy ManTech Program schedules periodic program reviews for the four shipbuilding affordability portfolios. In these reviews, the platform's IPT assesses the overall portfolio as well as individual projects with respect to technical progress, cost and schedule progress, and probability of implementation to meet the platform's window of opportunity.

Technology Roadmaps. Technology roadmaps have been developed for all four ship platforms and are shared with both the platform Program Offices and the relevant industry to ensure that Navy ManTech is investing in the highest priority areas for that particular platform.

Affordability Assessments. To review progress towards meeting both platform and ManTech affordability goals, affordability assessments are conducted semi-annually. In these assessments, cost avoidance/savings per project as well as estimated total savings per platform are identified and bought off by both the Program Office and the industry implementing the technology.

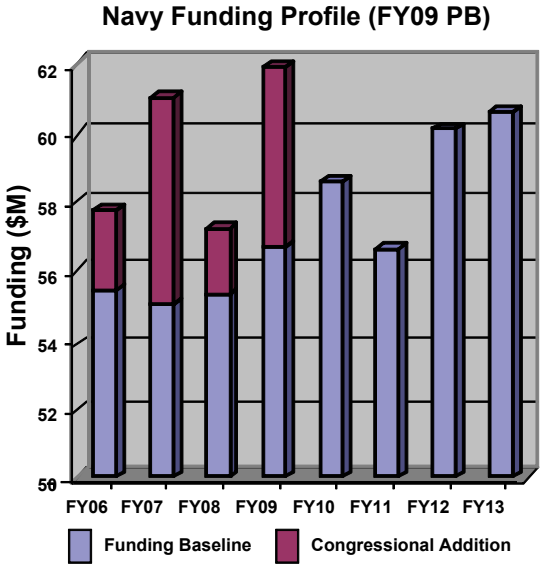
Technology Transition Plans. For each project, a Technology Transition Plan (TTP), which highlights the path from the technology development that ManTech performs to implementation on the factory floor, is developed. Implementation actions, roles and responsibilities, and required resources are identified. TTPs are signed by Navy ManTech, the relevant

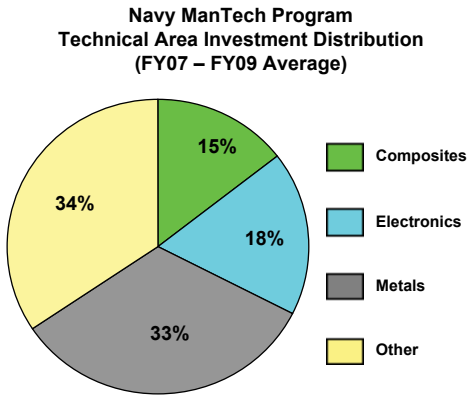
COE Director, a management representative of the industrial facility where implementation will occur, the Program Office, and, if appropriate, the Technical Warrant Holder.

Investment Profile

Funding for the Navy ManTech Program is approximately $60 million per year within the FY06-FY13 timeframe. Funding has remained relatively stable for the past ten years and is expected to continue at approximately that level. Congressionally directed funding is relatively small, as shown in the above table. The Navy's investment portfolio is distributed across the technology areas as shown in the adjacent graphic, representing a relatively even distribution among all technology areas.

Navy ManTech Program Funding Profile (PE 0708011N) -- $M								
	Appropriated				Requested (FY09 PB)			
	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13
Baseline	55.5	55.0	55.3	56.7	58.6	56.5	60.0	60.6
Cong. Adds	2.3	6.0	1.9	5.2				
Total	57.8	61.0	57.2	61.9	58.6	56.5	60.0	60.6





Strategic planning is an ongoing effort. Navy ManTech annually analyzes acquisition scenarios/plans to determine major ship and aircraft acquisition programs that might benefit from a close partnership with Navy ManTech. Platforms for investment are determined by total acquisition funding, stage in acquisition cycle, platform cost reduction goals, and cost reduction potential for manufacturing, all of which determine platforms for in vestment. As the four platforms currently supported mature through their respective acquisition cycles, ManTech's investment targets will change.

Summary

With affordability as its focus, Navy ManTech is committed to working with acquisition programs and industry to provide the technology needed to reduce production costs. The continued collaboration of ManTech, Program Offices, and industry on cost-reduction opportunities can and will help platforms achieve their affordability goals.

Air Force ManTech Program

Overview

Air Force ManTech develops, demonstrates, and transitions advanced manufacturing processes and technologies to reduce costs, improve quality/capability, and shorten cycle times of weapon systems during design, development, production, and sustainment. The Air Force ManTech major program tenets are: improvement of manufacturing processes and technologies; collaboration with government program offices, industry, and academia; investments in generic technologies that can be applied to different applications for technologies that are beyond a reasonable risk level for industry alone; cost-sharing; multiple system/customer applications; potential for significant return on investment; and customer commitment to implement. ManTech projects include efforts that respond to government program office acquisition and sustainment requirements to reduce cost, schedule, cycle time, and risks during transition of technology as well as collaboration with Air Force Research Laboratory for technology transition into weapon system programs. In addition, ManTech objectives are conducted through partnership with all industry levels, from large prime contractors to small material and parts vendors.

Organization

AF ManTech resides within the AF Materiel Command (AFMC) and is a division of the AF Research Laboratory's (AFRL) Materials and Manufacturing Directorate. The Materials and Manufacturing Directorate is one of ten directorates in AFRL. Direct oversight of all AFRL activities lies with the Deputy Assistant Secretary of the Air Force for Science, Technology, and Engineering (SAF/AQR).

Service Focus

AF ManTech strives for a balanced investment mix across air, space, and cyberspace systems, but in the near term a particular focus is on advanced propulsion, stealth, and sensors for fighter and strike systems. Priorities are set based on higher headquarters strategic guidance (for example, AF Strategic Plan, AF Roadmap, AF Capabilities Review and Risk

Assessment, AFRL Strategic Plan), assessments of acquisition and AFRL program requirements, and insight into industry opportunities (such as IR&D).

To ensure collaboration and to avoid duplication of efforts, ManTech reaches out to far-term and high-risk technologies. This complementary positioning of ManTech and Program Office investments ensures that the full spectrum of technology advancements are researched and pursued.

Successes

AF ManTech has a long and illustrious history of impacting the AF with cost reductions and capability improvements. These investments have resulted in cost reductions of billions of dollars. For example, the late 1980s project, Retirement for Cause, which successfully implemented life extension technologies for turbine engines, saved over $500 million in its first 10 years and continues to lower costs today. A few recent examples of high profile successes in producibility, affordability, and capability are provided below.

Active Electronically Scanned Array (AESA) Radar. AESA radar systems are the radar of choice for the F-22A, F-35, and future systems needing advanced radar capabilities–they are, however, very expensive, prohibitively so for some systems. AF ManTech worked with program offices and industry partners to identify manufacturing related cost drivers. Investing $9.6 million between FY04 and FY07, AF ManTech captured a cost reduction of $760 million for current generation AESAs. This is a 79:1 return on investment.

Alternate High Frequency Material (AHFM). Stealth sub-systems are a major cost driver for many AF weapon systems. ManTech worked with suppliers and identified a solution to enhance stealth material producibility for the B-2 system. With a $3.6 million investment, ManTech improved material delivery schedule and production costs, optimized the production formula, and reduced the standard delivery time from 26 weeks to 12 weeks. Overall efforts provide a projected material cost reduction of $239 million over 20 years. Finally, by enabling the B-2 fleet to use the new stealth technology, the B-2 mission capable rate doubled and maintenance hours on these stealth aspects were cut by 50%.

Joint Programmable Fuze (JPF). JPF is the next-generation programmable fuze for JDAM and several other AF/Navy munitions, providing a better (impact survivable) fuze capable of operating with multiple firing delay settings while being cockpit selectable, which enables greater targeting flexibility and lethality. AF ManTech assistance was requested by the PEO to support transition to production after repeated failed acceptance tests. Partnering with industry, AF ManTech used Lean and other advanced industrial practices to solve various manufacturing issues. This led to successful achievement of first article acceptance test and later low-rate initial production, with successful ramp-up to

full production. The ultimate benefit is that the warfighter has in-flight reprogrammable fuze capability to meet specific air-to-ground weapons requirements on demand.

Initiatives

The Advanced Manufacturing Propulsion Initiative (AMPI) is expected to transform the U.S. propulsion supplier base by increasing the affordability of current technologies and raising the manufacturing readiness level of advanced materials to enable the cost-effective production of high performance engine designs. AMPI is focused on seven priority technologies enabling increased performance and maintenance cost reductions. This joint service, a collaborative effort involving the three engine OEMs, their key suppliers, and the DoD, is using the F-35 engine as a demonstration target. AF ManTech, OSD MS&T, SBIR and other funding are being harnessed to create as much of the potential $10 billion of cost avoidance and 435 lbs per engine of weight savings, as funding and time will permit.

In addition to ongoing efforts in the traditional areas of affordability and producibility, AF ManTech is partnering with the JDMTP to advance the use of Manufacturing Readiness Levels (MRLs) and Manufacturing Readiness Assessments (MRAs). MRAs are conducted to baseline a program from a manufacturing point of view and to identify the risks associated with the manufacturing maturity of the program. AF ManTech is also investing in educating key program personnel on MRLs and MRAs and is supporting higher headquarters to incorporate MRLs into policy documents. In addition, AF ManTech has led MRAs on various acquisition programs and on all of AFRL's high-visibility Advanced Technology Demonstrators.

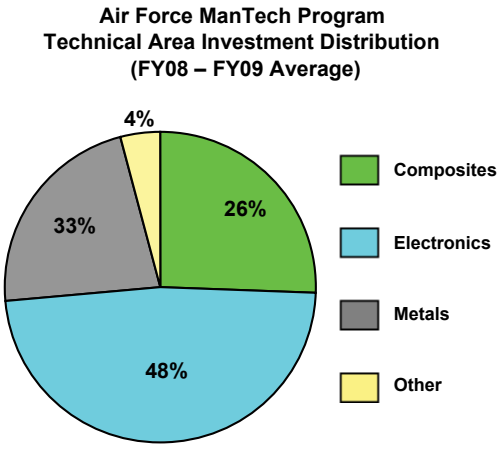
Program Reviews

Program Initiation. A headquarters-chaired Executive Steering Group, which includes balanced senior representation from AF mission areas, meets semi-annually to provide investment strategy guidance to ManTech and related industrial base programs. Any new projects are examined by a directorate-level Technical Review Board to ensure technical plan quality and to stimulate collaboration with the S&T community. Each program is required to create an implementation plan in collaboration with implementation stakeholders which matures through the life of the program.

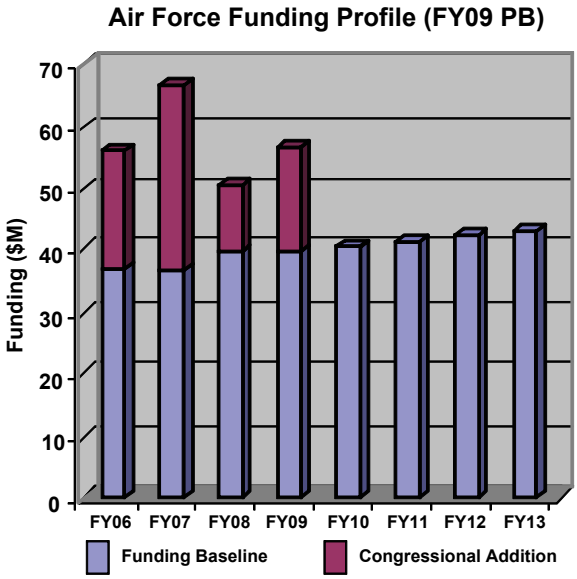
Program Progress. The Air Force follows a multi-tiered assessment schedule. A Laboratory Management Review process governs and monitors any changes to baseline technical, cost, and schedule throughout the year and culminates in an annual ManTech Division Chief review that also examines MRL and status against program implementation plans. ManTech's largest and highest-visibility programs are subject to a semi-annual AFRL-level review, called a program baseline review, which tracks progress against program baselines and emphasizes progress in the manufacturing readiness level for both ManTech programs and high-visibility advanced technology demonstrator programs.

Investment Profile

Air Force ManTech has three major investment thrusts: manufacturing readiness, PEO affordability and producibility, and sustainment. The Air Force's investment thrusts are distributed across the technology areas as shown in the adjacent graphic, with the largest investment in the electronics area. Requirements developed in each of these thrusts drive activities across all Air Force product lines including: Aeronautical; Armament; Directed Energy Systems; Command & Control Intelligence, Surveillance & Reconnaissance (C2ISR) Electronics; and Space Systems.



	Air Force ManTech Program Funding Profile (PE 0603680F) -- $M							
	Appropriated				Requested (FY09 PB)			
	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13
Baseline	36.9	35.7	39.9	39.7	40.5	40.8	41.6	42.5
Cong. Adds	19.0	29.7	10.6	16.8				
Total	55.9	66.4	50.5	56.5	40.5	40.8	41.6	42.5



Funding for the Air Force ManTech Program is stable at approximately $40 million per year across the FY06-FY13 timeframe, down from an average of $60 million per year during FY00-FY05. Congressionally directed funding is moderate, averaging $20 million per year (FY06-FY09) as shown in the above table. In FY09, the AF Manufacturing Technology program will transfer to PE 0603680F, Manufacturing Technologies, from PE 0708011F, Industrial Preparedness, to enhance the program's ability to work technology transition opportunities and to improve balance among near and far term priorities.

Summary

AF ManTech is a capability and affordability multiplier. Serving as the only AF corporate program to work strategic issues and opportunities in manufacturing readiness, it has a proven track record of impacting cost, schedule, and performance in acquisition and sustainment. AF ManTech will continue to pursue high-return opportunities across the acquisition and sustainment spectrum and lead the Air Force in implementation of MRL methodology.

Defense Logistics Agency (DLA) ManTech Program

Overview

DLA's Research and Development activities are funded through two program elements focused on the eight major supply chain areas. These two program elements are: Logistics Research and Development (PE 0603712S) and Manufacturing Technology (PE 0708011S). DLA ManTech supports a portfolio of investments in five of the eight DLA supply chains. ManTech is focused on strengthening the DLA industrial base associated with the clothing and textiles, subsistence, and maritime, land, and aviation supply chains (Figure 1). Logistics R&D is focused on internal DLA business processes and the intersection of private sector and DLA business processes. ManTech's focus and current investment in each area is depicted in white.

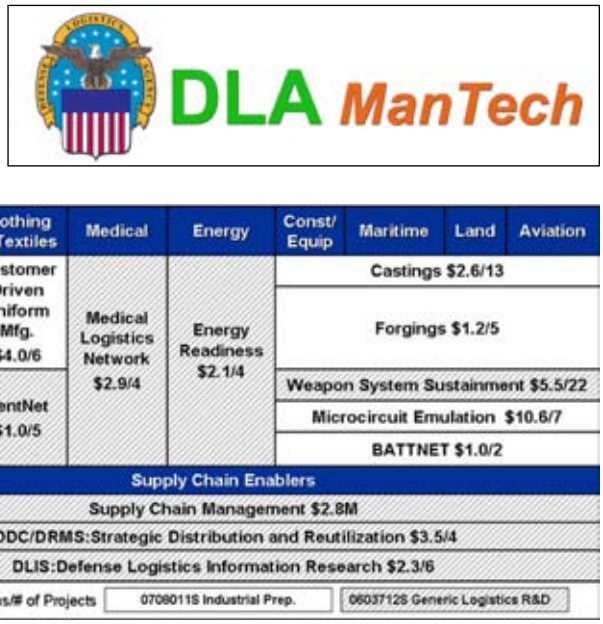


Figure 1. DLA R&D Program

Organization

DLA ManTech falls under the J-3/4 Logistics Operations and Supply Directorate (Figure 2). J-3/4 is responsible for the end-to-end supply chain management of the DLA's eight supply chains, providing logistics and materiel process management policy, guidance, oversight, and monitoring of supply chain performance. Within J-3/4 DLA ManTech falls under J-332, the Business Integration Division. J-332 coordinates and administers the transformation of processes, methods, and metrics of all policies under the purview of J-33.

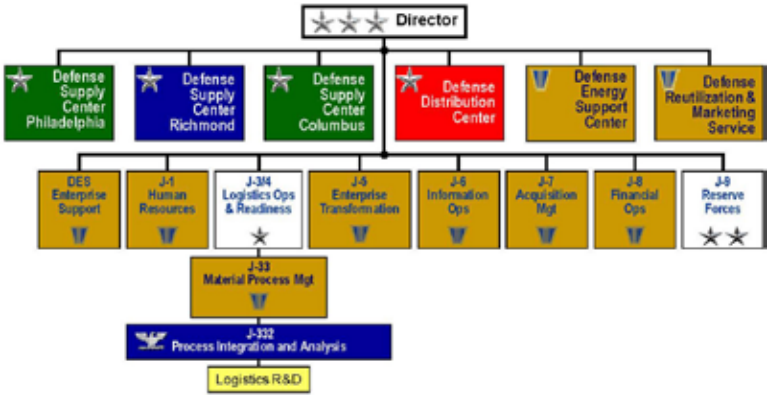


Figure 2. DLA R&D Organizational Placement

Agency Focus

The Defense Logistics Agency supplies the nation's military services and several civilian agencies with the critical resources they need to accomplish their worldwide

missions. DLA provides wide-ranging logistical support for peacetime and wartime operations, as well as emergency preparedness and humanitarian missions. DLA supplies almost every consumable item America's military services need to operate, from meals to jet fuel. In short, if America's forces can eat it, wear it, drive it, or burn it, chances are that DLA helps provide it. DLA also helps dispose of materiel and equipment that is no longer needed.

Successes

The Key Performance Indicator for DLA ManTech is implementation of project results. Results from each ManTech Supply Chain portfolio investment have been implemented (Figure 2).

Figure 2. DLA ManTech Implementations

Microcircuit Emulation Program. A microcircuit's lifecycle is typically 3-5 years, but a DoD system lifecycle is 10 years or more. This life cycle mismatch can result in production line shutdowns, constant redesign, and non-mission capable equipment when microcircuits are unavailable from the original manufacturing source. To combat this, DLA ManTech has established a trusted, continuing flexible manufacturing capability with supporting reverse engineering, design, test, and packaging for qualified form, fit, and function microcircuits. This is an onshore ability to support more than 350 unique weapon systems with a cost avoidance over $500 million.

Combat Rations Program. DLA's program to improve Meals-Ready to Eat (MREs), the food that powers our combat forces, involves every manufacturer of rations. The results have been an enormous improvement in the cost, quality, and acceptability of combat rations. Prior to the DLA ManTech Program for MREs, the menu was limited to stews and similar items that could be pumped into MRE pouches. Although nutritious, these "pumpable" meals were not as satisfying a whole meat items. The ManTech Program developed the packaging machinery that enables whole meat products to be cost-effectively included in combat ration menus.

Castings and Forgings Program. These programs work on a variety of problems affecting the ability of foundries and forges to meet DoD requirements. First and foremost, the programs have identified tooling needed to make DoD parts. By identifying the source of the original casting or forging tooling, the original foundry or forge can supply the item either to DLA directly or to another manufacturer for finishing into the final product.

Apparel Research Network. The program has fielded technology that links the military recruit into the supply chain that supplies the items they receive in basic training. The technology is implemented in over 300 manufacturers and allows for very accurate tracking of clothing items from the manufacturer to the recruit induction center. It is deployed in 8 of 9 recruit centers.

Initiatives

Batteries. The ManTech program is starting one new portfolio investment in military-unique batteries. Today's warfighter is more dependent than ever on personal electronics, such as night vision goggles. Demand surges for batteries when military operations begin. During OIF/OEF the industrial base was very fragile and incapable of meeting the surge demands for the operation. Batteries were the only item of supply that limited the commander's flexibility during these operations. To address this problem, DLA ManTech is beginning the BATTNET program in FY10.

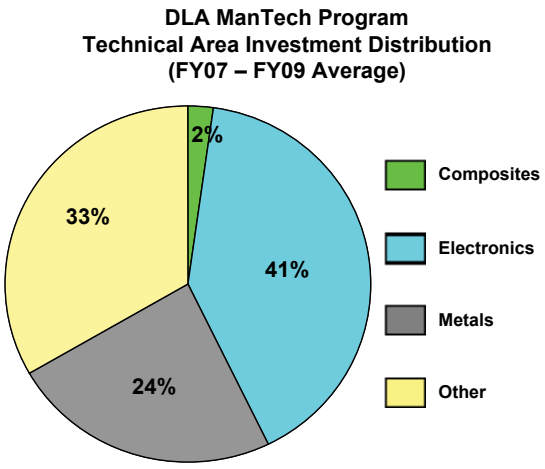
Industrial Base Innovation Fund (IBIF). The IBIF is a Congressionally Directed Fund program executed by DLA on behalf of DoD. IBIF accounts for the large jump in CDF programs shown in Figure 3 for FY08 and FY09. IBIF is a partnership between OSD Industrial Policy, OSD AS&C and the Joint Directors Manufacturing Technology Programs (JDMTP). The funding resulted in 25 individual projects competitively selected from ongoing projects in a full and open competition. A full report of the IBIF awards can be found on the OSD IP website. Projects selection for FY09 will be selected in a manner similar to FY08.

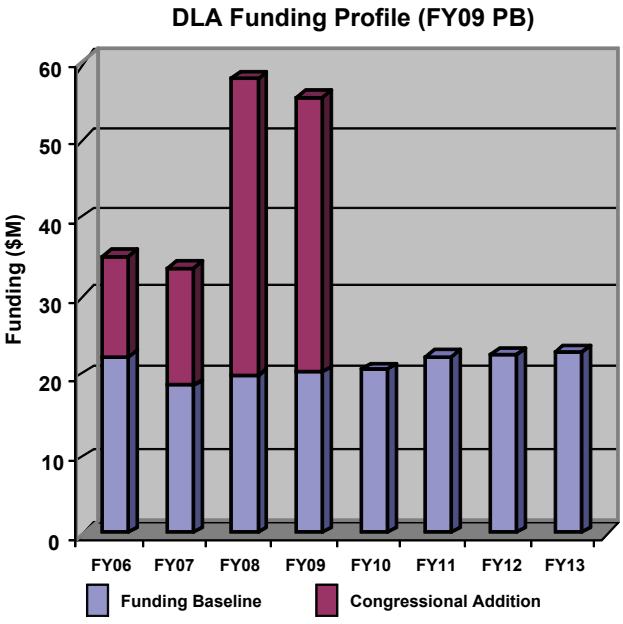
Program Reviews

The DLA R&D program reviewed semi-annually by each supply chain owner and by the corporate board during the budget review cycle.

Investment Profile

DLA's ManTech Program has been in place since FY83, and has an average funding of $20 million over the FY06-FY13 timeframe. The adjacent table shows





DLA's ManTech funding profile, including the congressionally added funding, which has more than doubled the DLA ManTech budget from FY06 through FY09. The addition of the Industrial Base Innovation Fund (averaging $20 million over FY08-FY09) is responsible for the large growth in these years. DLA's ManTech investment portfolio is distributed across the technology areas as shown in the above graphic.

DLA ManTech Program Funding Profile (PE 0708011S) -- $M								
	Appropriated				Requested (FY09 PB)			
	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13
Baseline	22.5	18.7	20.0	20.5	20.8	21.3	21.7	22.0
Cong. Adds	12.7	15.0	37.7	34.8				
Total	35.2	33.7	57.7	55.3	20.8	21.3	21.7	22.0

Summary

DLA ManTech continues to refine its ability to respond quickly and effectively to the needs of the military. With a history of progress in manufacturing technologies and processes, DLA ManTech's future will see continued success in acquisition best practices and manufacturing process development.

Missile Defense Agency Producibility and Manufacturing Program

Overview

The Missile Defense Agency (MDA) is charged with developing and fielding an integrated, layered, Ballistic Missile Defense System (BMDS) to defend the United States, its deployed forces, allies, and friends against all ranges of missiles in all phases of flight. To ensure mission effectiveness, MDA continues to develop, test, and field an increasingly capable system of interceptors, sensors, and command and control systems to improve the depth, range, and reliability of our defenses. As with any such DoD mission, producibility and manufacturability are key enablers of capability enhancing technologies. Since MDA does not house a ManTech directorate, these issues are tasked to the Producibility and Manufacturability directorate under the MDA Deputy for Engineering. The Producibility and Manufacturing Directorate is assessing and mitigating producibility and manufacturing risks.

Organization

In addition to its special staff and various administrative offices, the MDA has six major divisions focused on ballistic missile defense technologies: agency operations, acquisition management, advanced technology, international affairs, engineering, and integration and fielding. While MDA does not have a formal ManTech Program, its producibility and manufacturing directorate bears a close resemblance to the Service and DoD Agency ManTech programs. The Deputy Director for Engineering (MDA/DE) is charged with overseeing all engineering activities. Direct responsibility for the producibility and manufacturing directorate is further delegated to the MDA/DEP. Figure 1 highlights the position of the DEP within the larger MDA organization.

Figure 1. MDA Organization

MDA/DEP is responsible to the MDA director for ballistic missile defense (BMD) system-wide producibility and manufacturing risk assessment and mitigation. DEP supports BMD elements by identifying and helping to mitigate risks impacting mission assurance, performance, schedule, and cost. The Producibility and Manufacturing directorate has five major functions:

- Assess priority BMDS risks related to producibility, manufacturing, quality, schedule, and cost.
- Serve as the MDA technology transition lead; ensure that technologies and products under development are mapped into the BMDS architecture at the appropriate insertion points.
- Assess MDA technology program's applicability to BMDS requirements and their readiness for transition.
- In concert with the elements, assess and report transition readiness using engineering manufacturing readiness levels (EMRLs) and exit criteria metrics (that is, critical knowledge points)
- Conduct MDA industrial base assessments and identify shortfalls/gaps affecting BMDS Element acquisitions. Support OSD and other agencies in remediation efforts.
- In concert with the elements, develop industrial and manufacturing investment strategies for system affordability and insertion of successive new capabilities.

Each of these functions supports the directorate's plan to tackle system-wide problems in affordability, technology and product transition, supply chain management, manufacturing assessments, and producibility risks.

Agency Focus

MDA/DEP is focused on developing and applying innovative manufacturing processes that improve capabilities, sub-systems and component performance, product quality and reliability, reduce unit costs, reduce cycle time, reduce process variability, and enhance manufacturing yields. Thrust areas include:

- Advanced missile materials and process technologies.
- BMDS innovative power generation and storage devices.
- Improved manufacturing processes for propulsion technology.
- Innovative manufacturing technologies for low-cost, high-reliability electronic packaging.
- Manufacturing technology innovations for advanced electro-optical components and systems for missile defense applications.
- MDA supply chain management for small- and medium-sized enterprises.
- Mitigating lead-free issues in electronic circuit board manufacturing and repair.
- Production enhancements for integrated anti-tamper technologies.

Successes

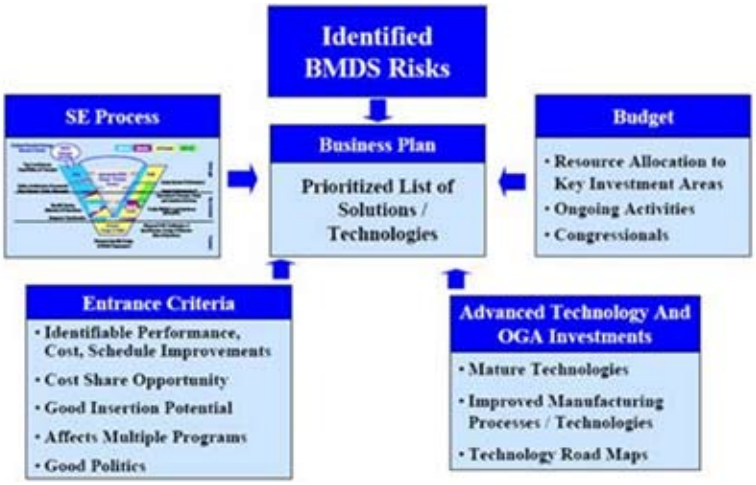
With numerous initiatives underway, MDA has most recently seen success in its anti-tamper and supply chain mapping tool Programs.

Anti-Tamper (AT) Program. MDA developed a draft MDA anti-tamper standard and is now working with the DoD anti-tamper executive agent to use this as the model for a DoD-wide standard.

Supply Chain Mapping Tool. This tool utilizes the QS supplier database and enhances MDA's ability. At all times, MDA can view critical supplier locations, natural and manmade disasters, and industrial base health.

Investment Profile

In order to accurately assess and predict which solution and technology areas require investment, MDA/DEP follows a structured and consistent process, as seen in Figure 3. In this process, key elements contribute to prioritizing the list of technologies. Entrance criteria are determined and the technology must stand up to specific questions regarding its application to multiple programs and its insertion potential within industry. Other elements measure the technology's cost against the overall program budget to determine if adequate resources are in place. Still other analysis elements look to advanced technologies on the cusp of production to determine their maturity level–is the technology mature enough to be developed with low risk? Also formulated into the equation for investment are previously identified risks and systems engineering process. Once all aspects of a potential solution are considered, a business plan is developed for pursuit of the identified solutions and technologies.



Though specific focus areas may vary across the future year defense plans, the directorate's investment portfolio is relatively consistent. Typically, programs fall within one of eight traditional investment areas: power systems, radiation hardening, manufacturing processes, EO/IR, radar and RF/electronics, propulsion, anti-tamper, and advanced materials.

Investment Areas	Focus On
Power Systems	- Alternative high energy density power systems technology - Long duration rechargeable power storage device - High energy density solar array
Radiation Hardening	- Radiation hardened & radiation tolerant devices - Rad Hard Catalogue, alternate techniques, Silicon Carbide and Gallium Nitride - Radiation Hard Oversight Council Interface - Hardness by design - Producibility and reliability testing - Inertial Measurement Units
Manufacturing Processes (Including Software)	- Utilize commercial processes - Lean / Six Sigma - Supply chain management - Software - EMRLs - Parts obsolescence
EO / IR (Including Lasers)	- IR Focal plane array multiple manufacturing sources - Ultraviolet, very long wave infrared, cryocoolers, seeker assemblies, telescopes
Radar & RF / Electronics	- Improve sensor performance, sensitivity, and processing capability - Thermal management, Transmit / Receive modules, Transmit Receive Integrated Microwave Modules, Wide Bandgap, high-power Gallium Arsenide - Real-time processing, image processing, stacked integrated circuits
Propulsion	- Lightweight, erosion-resistant ultra high temperature materials - Material characterization - Low cost actuators / valves
Anti-Tamper	- Protect BMDS critical technologies - Extend the effective operational life of the BMDS
Advanced Materials	- Beryllium replacement on KV - Missile launch canisters - PAC-3 and KEI radomes - KEI nose cones - KEI thermal protection systems - Missile body and KV structures - KV sunshades

Summary

MDA's producibility and manufacturing mission and functions address critical BMD needs and issues. The program effectively reduces transition risk through the use of low-cost prototype demonstrations and ground and flight experiments and utilizes structured processes to identify investment areas and products. MDA/DEP's use of maturity level demonstrations and structured investment processes will enable it to continue to addresses system-wide issues in affordability, commonality, and modularity.

Defense Advanced Research Projects Agency (DARPA) Manufacturing Related Programs

Overview

DARPA's role is to provide radical innovation for national security. Though focused primarily on product technology, DARPA's innovation and development of new products has an inherent impact on manufacturing technology. DARPA's investments in advanced materials and microelectronics technology, for example, have been the foundation for entire industries that have grown into a production base for critical defense and commercial components. Thus, while DARPA has no ManTech program per se, it is an important contributor to defense manufacturing technology.

Organization

DARPA's technical staff and programs are organized in five technology offices:

- *Defense Sciences Office.* Vigorously pursues the most promising technologies within a broad spectrum of the science and engineering research communities and to develop those technologies into important, radically new military capabilities.
- *Information Processing Techniques Office* (IPTO). Understands the world: from sensing to cognition, IPTO brings the future of computing to the warfighter by supporting research, applied research, and prototyping in cognitive systems, command and control, computer language translation, high productivity computing, and sensors and processing.
- *Microsystems Technology Office.* Integrates heterogeneous microchip-scale electronics, photonics, and microelectromechanical systems (MEMS). Their high-risk/high-payoff technology is aimed at solving the national level problems of protection from biological, chemical and information attack and to provide operational dominance for mobile distributed command and control, combined manned/unmanned warfare, and dynamic adaptive military planning and execution.
- *Strategic Technology Office* (STO). Researches, demonstrates, develops, and transitions technologies and systems that enable strategic military operations throughout the spectrum of conflict. Investments range from the development of enabling technologies to the demonstration of integrated prototypes, with the goal of superior cost-effective assets the military can use to respond to present and emerging threats.
- *Tactical Technology Office.* Engages in high-risk, high-payoff advanced military research, emphasizing the "system" and "subsystem" approach to the development of aeronautic, space, and land systems as well as embedded processors and control systems.

Thrusts and Core Technologies

Unlike the Military Departments and DLA, DARPA does not designate any particular office as its manufacturing technology section, but rather addresses manufacturing as needed within the technology programs of each office. In 2007, DARPA identified Manufacturing Science and Technology as a core technology in the DARPA Strategic Plan. DARPA believes that to ensure reliable, robust, and cost-effective access to items resulting from DARPA programs, manufacturing technologies that can meet DoD's needs must be available in the DoD industrial base. When a manufacturing breakthrough is needed to make production of the item possible, DARPA invests in the applicable manufacturing technologies and develops a transition strategy that makes good business sense.

For example, the DARPA maskless direct-write nanolithography for defense applications program will develop a maskless, direct-write lithography tool to address both the DoD's need for affordable, high-performance, low-volume integrated circuits and the commercial market's need for highly customized, application-specific integrated circuits. This program, based on writing circuits rather than printing them, will also provide a cost-effective manufacturing technology for low-volume nanoelectromechanical systems and nanophotonics initiatives within DoD. Maskless lithography tools, installed in the Trusted Foundry and in commercial foundries, will enable incorporation of state-of-the-art semiconductor devices in new military systems and will allow for the cost-effective upgrade of legacy military systems.

Though specifically addressed in the manufacturing and science core technology, DARPA has many core technologies (and goals within each) that will bring about the implementation of new product and/or process technologies that will require changes, and in some instances drastic leaps forward, in manufacturing technologies. Additional examples that will impact the defense and commercial manufacturing base are provided below.

Technology Area	Program	Defense Impact
Material Production	Titanium	Radically reduces the price of titanium to less than four dollars per pound for military-grade quality material
Disruptive Manufacturing	Composites Precision airfoils Personnel armor Traveling wave tube amplifiers	• Nonautoclave manufacturing technology for production of polymer matrix composites • Precision airfoils through digital direct fabrication • Low cost synthesis of boron carbide armor for all personnel and vehicles via plasma synthesized nanoscale powder and pressureless sintering • New class of microfabricated 3D coaxial lines and matching structures optimized for radio frequency performance to enable affordable solid-waste TWTAs and rapid prototyping for new applications

Technology Area	Program	Defense Impact
Micro Systems	(MEMS) into "systems-on-a chip" and micro-scale chemical and biological sensors	Spectacular reduction in transistor circuit size; micro-scale miniaturization, lower power, higher performance
Bio-Info-Micro	Accelerated manufacturing of pharmaceuticals	Manufacture millions of doses of complex new therapeutics within 12 weeks
Software	Software Producibility	Achieve advanced capability at greatly reduced cost via technologies that allow for more rapid and efficient software development and maintenance

Material Production. DARPA has demonstrated a production process that offers the potential for radically reducing the price of titanium to less than four dollars per pound for military-grade metal. This program is now moving from the feasibility stage to a prototype operation. This will be a true paradigm shift in the use of titanium, as occurred with aluminum once it was no longer a precious metal but could be produced economically.

Disruptive Manufacturing Technologies. The central goal of this program is to develop and demonstrate disruptive manufacturing technologies that reduce the cost and time of production of key systems and that will have a pervasive impact on current and future DoD systems and platforms. Manufacturing capabilities that are affordable at small volume and that reduce production time are needed for spiral upgrades to fielded systems and to provide a capability for production of legacy parts. The focus of this program is manufacturing process development; challenge problems for manufacturing are parts/materials now bought by DoD that provide benchmarks for cost and production time. New manufacturing capabilities developed for existing production will also be used for future systems and platforms.

Microsystems. DARPA is working to combine microelectronics, photonics, and MEMS into "systems-on-a chip" that have new capabilities. Examples include integrating MEMS with radio frequency electronics and photonics, integrating photonics with digital and analog circuits, and integrating radio frequency and digital electronics to create mixed signal circuits. The model for this integration is the spectacular reduction in transistor circuit size. The program will harness the advantages of micro-scale miniaturization to yield tiny (if not chip-scale) gyroscopes with navigation-grade performance. Manufacturing issues are being addressed as an inherent part of these programs.

Microscale chemical and biological sensors are also being developed by scaling macroequipment to micro-scale systems for lower power and higher performance. The Micro Gas Analyzer program is shrinking the equivalent of a chemical laboratory gas chromatography mass spectrometer–the size of a large laser printer–into one cubic centimeter.

Bio-Info-Micro. DARPA's new 'bug-to-drug' program seeks to accelerate the manufacturing of pharmaceuticals to revolutionize the scale and speed of vaccine and pharmaceutical manufacturing. The Accelerated Manufacturing of

Pharmaceuticals program is exploring several difficult but plausible solutions for manufacturing millions of doses of a complex new therapeutic within 12 weeks. The manufacturing base will hold the responsibility to consistently produce quality vaccines in the massive quantities and quick timelines set forth in the bug–to–drug program.

Summary

DARPA has a fifty-year history of advances in smaller, lighter, faster technologies that continue to change the way we fight. These technologies have successfully transitioned to production because the needed manufacturing process technologies were co-developed with the product technology. Designating Manufacturing Science and Technology as one of DARPA's strategic core technology areas will further emphasize this approach in the future. As an ex-officio member of the Joint Defense ManTech Program Panel, DARPA will continue to coordinate its programs with the ManTech investments of the Military Departments, DLA and OSD.

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7. NDIA Manufacturing Division Quarterly Conference, August 13-14, 2008
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9. Joint Defense Manufacturing Technology Panel (JDMTP) semi-annual "All-Hands" Conference, October 28-29, 2008
10. NDIA Manufacturing Division Quarterly Conference, November 12-13, 2008
11. Defense Manufacturing Conference, December 1-4, 2008

* Note: Does not include other frequent, routine interactions with JDMTP principals and staffs.

ANNEX E: ACRONYMS AND ABBREVIATIONS

AESA	active electronically scanned array
AFMC	Air Force Materiel Command
AFRL	Air Force Research Laboratory
AHFM	alternate high frequency material
AIA	Aerospace Industries Association
AME	Advanced Manufacturing Enterprise
ARL	Army Research Laboratory
ASTWG	Army Science and Technology Working Group
ATO-D	Army Technology Objective – Development
ATO-M	Army Technology Objective – Manufacturing
B2PCOE	Benchmarking and Best Practices Center of Excellence
BAA	broad agency announcement
BMD	Ballistic Missile Defense
BMDS	Ballistic Missile Defense System
C2 ISR	command and control intelligence, surveillance, and reconnaissance
C4ISR	command, control, communications, computers, intelligence, surveillance and reconnaissance
CAD	computer aided design
CDF	congressionally directed funding
CDUM	customer driven uniform manufacturing
CMC	ceramic matrix composite
CMTC	Composites Manufacturing Technology Center
CNST	Center for Naval Shipbuilding Technology
COE	center of excellence
CVN 21	Navy's next generation aircraft carrier program
DAC	Defense Acquisition Challenge
DARPA	Defense Advanced Research Project Agency
DAU	Defense Acquisition University

DDG 1000	Navy's next generation destroyer program
DDR&E	Director of Defense Research and Engineering
DFM	defense for manufacturability
DHS	Department of Homeland Security
DIRCM	directional infrared countermeasures
DLA	Defense Logistics Agency
DoC	Department of Commerce
DoD	Department of Defense
DoDD	Department of Defense Directive
DoE	Department of Energy
DSB	Defense Science Board
DSTAG	Defense Science and Technology Advisory Group
DUSD (AS&C)	Deputy Under Secretary of Defense for Advanced Systems and Concepts
DUSD (A&T)	Deputy Under Secretary of Defense for Acquisition and Technology
DUSD (L&MR)	Deputy Under Secretary of Defense for Logistics and Materiel Readiness
EMPF	electronics manufacturing productivity facility
EMRLs	engineering manufacturing readiness levels
EMTC	Energetics Manufacturing Technology Center
EOC	Eletro-Optics Center
EW/GMTI	electronic warfare/ ground moving target indicator
FCS	Future Combat Systems
FCT	Foreign Comparative Testing
FNC	future Naval capabilities
FRC	fleet readiness center
FY	fiscal year
GAO	Government Accountability Office
GCM	global collaborative manufacturing
GDF	Guidance for the Development of the Force
HSLA	high strength low alloy
IB	industrial base
IBIF	Industrial Base Innovation Fund

IMAST	Institute for Manufacturing and Sustainment Technologies
IMU	inertial measurement unit
IPR	interim progress review
IPT	integrated process team
IPTO	Information Processing Techniques Office
IR&D	independent research and development
IR/EO	infrared/ electro-optics
JCA	joint capability area
JCIDS	Joint Capabilities Integration Development System
JDMTP	Joint Defense Manufacturing Technology Panel
JPF	joint programmable fuze
JWSTP	Joint Warfighting Science and Technology Plan
LCD	liquid crystal display
LCS	Littoral Combat Ship
LO	low observable
LWIR	long wave infrared sensors
ManTech	Manufacturing Technology
MDA	Missile Defense Agency
MDA/DEP	Missile Defense Agency Directorate of Engineering & Producibility
MEMS	micro-electromechanical systems
MILSVCs	military services
MISER	mobile integrated sustainable energy recovery
MMIC	monolithic microwave integrated circuits
MRA	manufacturing readiness assessment
MRE	meal ready to eat
MRL	manufacturing readiness level
MS	milestone
MS&T	Manufacturing Science and Technology
MSSC	Manufacturing Skill Standards Council
NACFAM	National Council for Advanced Manufacturing
NCAT	National Center for Advanced Technologies

NDAA	National Defense Authorization Act
NDE	non-destructive examination
NDIA	National Defense Industrial Association
NDS	National Defense Strategy
Net-Centric	network centric
NJC	Navy Joining Center
NMC	Navy Metalworking Center
NMS	National Military Strategy
NSF	National Science Foundation
NSRP	National Shipbuilding Research Program
ODUSD(IP)	Office of Deputy Under Secretary of Defense for Industrial Policy
ONR	Office of Naval Research
OSD	Office of the Secretary of Defense
PEO	program executive office
PM	program manager
PMR	program management review
POM	Program Objective Memorandum
PPBES	Planning, Programming, Budgeting, and Execution System
PQM	production, quality, and manufacturing
QDR	Quadrennial Defense Review
R&D	research and development
RDA	research, development, and acquisition
RDECOM	Research, Development, and Engineering Command
RDECs	research, revelopment, and engineering centers
REACH	Registration, Evaluation, Authorization, and Restriction of Chemicals
RF	radio frequency
S&T	science and technology
SA(ALT)	Secretary of the Army for Acquisition, Logistics ,and Technology
SAF/AQR	Deputy Assistant Secretary of the Air Force for Science, Technology, and Engineering
SATCOM	satellite communications
SBIR	Small Business Innovation Research

SecDef	Secretary of Defense
SiC/GaN	sillicon carbide/gallium nitride
SME	subject matter expert
SSBN	sub-surface ballistic nuclear (submarine designation)
SSN	sub-surface nuclear (attack submarine designation)
STEM	science, technology, engineering, and math
STO	Strategic Technology Office
STTR	Small Business Technology Transfer
TBO	time between overhaul
TTA	technology transition agreement
TTI	Technology Transition Initiative
TTP	technology transition plan
U.S.	United States
USC	United States Code
USD (AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics
VCS	Virginia Class Submarine
VED	vacuum electronic device
WBG	wide band gap
WTC	Warfighter Technical Council